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*We reserve the right to change the information in this manual without prior notice.

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DELTA Hybrid Energy System HES Series User Manual

DELTA
Hybrid Energy System
HES Series User Manual

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Preface

Thank you for choosing the Hybrid Energy System (HES) designed exclusively for the Delta Injection Machine, which consists of Hybrid Servo Controller (VFD-VJ) series and servo oil pump.

These production instructions provide the users with complete information regarding the installation, parameter configuration, anomaly diagnosis, troubleshooting, and routine maintenance of the Hybrid Servo Driver. To ensure correct installation and operation of the hybrid servo driver, please read the instructions carefully before installing the machine. In addition, please store the enclosed CD-ROM properly and pass down to the machine users.

The Hybrid servo driver is a delicate power electronics product. For the safety of the operators and the security of the machine, please only allow professional electrical engineers to conduct installation, tests, and adjust machine parameters. Please carefully read the contents of the instructions that are marked with "Danger" and "caution". Please contact your local Delta agents for any questions and our professional team will be happy to assist you.

PLEASE READ PRIOR TO INSTALLATION FOR SAFETY.

DANGER

- ☑ Make sure to turn off the power before starting wiring.
- ☑ Once the AC power is turned off, when the POWER indicator of the Hybrid Servo Controller is still on, it means there is still high voltage inside the Hybrid Servo Controller, which is very dangerous and do not touch the internal circuits and components. To conduct the maintenance safely, please make sure the voltage between ＋1 and － is lower than 25Vdc using the handheld multimeter before starting the operation.
- ☑ The internal circuit board of Hybrid Servo Controller houses CMOS IC, which is vulnerable to electrostatics. Please do not touch the circuit board by and without any anti-electrostatics measures.
- ☑ Never modify the components or wiring inside the Hybrid Servo Controller.
- ☑ The E⏚ terminal of Hybrid Servo Controller must be grounded correctly. The 230V series uses the third type of ground scheme while the 460V series uses special ground.
- ☑ This series of products cannot be operated in environments that endanger human safety.
- ☑ Please keep children or strangers from approaching Hybrid Servo Controller.

WARNING	☑ Never connect AC power to the output terminals U/T1, V/T2, and W/T3 of Hybrid Servo Controller. ☑ Please do not conduct stress test on the internal components of Hybrid Servo Controller, for the semiconductor devices therein may be damaged by high-voltage breakdown. ☑ Even when the servo oil pump is off, the main loop terminal of Hybrid Servo Controller can still be loaded with high voltage that can be seriously dangerous. ☑ Only qualified professional electrical engineers can conduct tasks of installation, wiring, and maintenance of Hybrid Servo Controller。 ☑ When Hybrid Servo Controller uses external terminals as its run command sources, the servo oil pump may start running immediately after the power is connected, which may be dangerous with any personnel present.
CAUTION	☑ Please choose a safe area to install Hybrid Energy System, where there is no high temperature, direct sunlight, moisture, and water dripping and splash. ☑ Please follow the instructions when installing Hybrid Energy System. Any unapproved operation environment may lead to fire, gas explosion, and electroshock. ☑ When the wiring between the hybrid controller and the hybrid servo motor is too long, it may compromise the interlayer insulation of the motor. Please install a reactor between them (please refer to Appendix A) to avoid burning of the hybrid servo motor from damaged insulation. ☑ The voltage rating of the power supply of Hybrid Servo Controller 230 series cannot be higher than 240V (no higher than 480V for 460 series) and the associated current cannot exceed 5000A RMS (no higher than 10000A RMS for models with 40HP (30kW))

NOTE

- To provide detailed product descriptions, the illustrations are made with the exterior cover or safety shield removed. When the product is running, please make sure the exterior cover is secured and the wiring is correct to ensure safety by following the instructions of the manual.
- The figures in the manual are made for illustration purposes and will be slightly different from the actual products. However, the discrepancy will not affect the interests of clients.
- Since our products are being constantly improved, for information about any changes in specifications, please contact our local agents or visit (http://www.delta.com.tw/industrialautomation/) to download the most recent versions.

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Chapter 1 Use and Installation

1-1 Exterior of Product

1-2 Product Specifications

1-3 Introduction of Hybrid Energy System

1-4 Product Installation

1-5 Product Dimensions

Upon receipt of the product, the clients are advised to keep the product in its original packaging box. If the machine won't be used temporarily, for future maintenance safety and compliance with the manufacturer's warranty policy, please pat attention to the following for product storage:

- ☑ Store in a clean and dry location free from direct sunlight or corrosive fumes.
- ☑ Store within an ambient temperature range of -20 °C to +60 °C.
- ☑ Store within a relative humidity range of 0% to 90% and non-condensing environment.
- ☑ Avoid storing the product in environments with caustic gases and liquids.
- ☑ Avoid placing the product directly on the ground. The product should be placed on suitable benches and desiccators should be placed in the packaging bags in harsh storage environments.
- ☑ Avoid installing the product in places with direct sunlight or vibrations.
- ☑ Even if the humidity is within the required value, condensation and freezing can still happen when there is drastic change of temperature. Avoid storing products in such environment.
- ☑ If the product has been taken out of the packaging box and in use for over three months, the temperature of the storage environment must be below 30°C. This considers the fact when the electrolytic capacitor is stored with no current conduction and the environment temperature is too high, its properties may deteriorate. Please do not store the product in the situation of no current conduction for more than one year.

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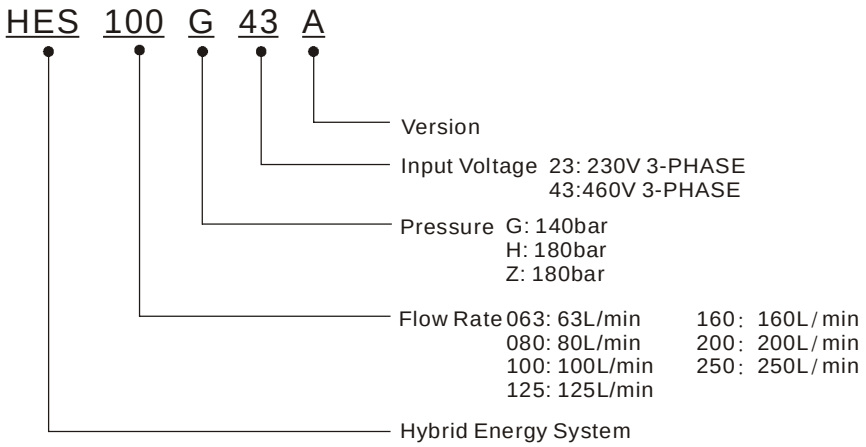
1-1 Exterior of Product

All Hybrid Energy System has passed strict quality control before being shipped out from the factory, with enforced packaging that sustains impacts. Upon opening the packaging of the Hybrid Energy System, the customers are recommended to conduct the examination by the following steps:

- ☑ Check if there is any damage to Hybrid Energy System during shipping.
- ☑ Upon opening the box, check if the model number of Hybrid Energy System matches that listed on the external box.

For any mismatch of the listed data with your order or any other issues with the product, please contact your local agent or retailer.

Model Explanation



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1-2 Specifications

230V Series Specifications

Model Number			HES____23A								
			063H	080G	080H	100G	100H	100Z	125G	125H	160G
Oil Pump Capacity		cc/rev	25	32		40			50		64
Flow Rate Specifications	Flow Rate	L/min	63	80		100			125		160
	Maximum Flow Rate*	L/min	75	96		120			150		192
	Linear	%	Below 1% F.S.								
	Magnetic Hysteresis	%	Below 1% F.S.								
Pressure Specifications	Maximum Pressure	Mpa	18	14	18	14	18	18	14	18	14
	Minimum Pressure	Mpa	0.1								
	Linear	%	Below 1% F.S.								
	Magnetic Hysteresis	%	Below 1% F.S.								
Servo Oil Pump Specifications	Power	kW	11					15			
	Insulation Grade		Grade A (UL)								
	Cooling Method		Forced Air Cooling								
	Environment Temperature		0 ~ 40 °C								
	Environment Humidity		20 ~ 90 RH (No condensation)								
	Weight	kg	82			83		95	108		110
Servo Controller Specifications	VFD-___VL23A-J		110		150		185	220		300	
	Maximum Output Voltage (V)		3-Phase Proportional to Input Voltage (200~240V, 50/60Hz)								
	Rated Output Capacity	kVA	19		25		29	34		46	
	Weight	kg	10		13		13	13		36	
	Brake Unit		Built-in							Plugged-in	
	Speed Inspector		Resolver (Revolving Transformer)								
	Pressure Command Input		0~10V Support three-point calibration								
	Flow Rate Command Input		0~10V Support three-point calibration								
	Multi-functional Input Terminal		5ch DC24V 8mA								
	Multi-functional Output Terminal		2 ch DC24V 50mA, 1 ch Relay output								
	Analog Output Voltage		1 ch dc 0~10V								
	Cooling Method		Forced Air Cooling								
	Environment Temperature		-10 ~ 45 °C								
	Environment Humidity		Below 90 RH (No condensation)								
	Protection Functions		Over current, over voltage, low voltage,, over heating, and overload in Hybrid Servo Controller and over heating, overload, and abnormal speed in Hybrid Servo Motor.								
Actuation Oil	Working Medium		HL-HLP DIN51 524 Part1/2 R68,R46								
	Operation Temperature	°C	-20 to 100								
	Viscosity	@40 °C	67.83								
		@100 °C	8.62								
Miscellaneous			Safety, Reactor, and EMI filter are optional.								

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460V Series Specifications

Model Number			HES____43A										
			063G	063H	080G	080H	100G	100H	100Z	125G	125H	160G	160H	200G
Oil Pump Capacity		cc/rev	25		32		40			50		64		80
Flow rate Specifications	Flow Rate	L/min	63		80		100			125		160		200
	Maximum Flow Rate*	L/min	75		96		120			150		192		240
	Linear	%	Below 1% F.S.											
	Magnetic Hysteresis	%	Below 1% F.S.											
Pressure Specifications	Maximum Pressure	Mpa	14	18	14	18	14	18		14	18	14	18	14
	Minimum Pressure	Mpa	0.1											
	Linear	%	Below 1% F.S.											
	Magnetic Hysteresis	%	Below 1% F.S.											
Servo Oil Pump Specifications	Power	kW	11						15				20	
	Insulation Grade		A grade (UL)											
	Cooling Method		Forced Air Cooling											
	Environment Temperature		0 ~ 40 °C											
	Environment Humidity		20 ~ 90 RH(No condensation)											
	Weight of Servo Oil Pump	kg	82				83		95	108		110		144
Servo Controller Specifications	Model NumberVFD-___VL43A-J		110	150		185		220			300		370	
	Voltage of Power Supply		Three-Phase Power Supply 200 ~ 240V, 50/60Hz											
	Rated Output Capacity	KVA	19	25		29		34			46		56	
	Weight	kg	10	13		13		13			36		36	
	Brake Unit		Built-in								Plugged-in			
	Speed Inspector		Resolver(Revolving Transformer)											
	Pressure Command Input		0~10V Support three-point calibration											
	Flow Rate Command Input		0~10V Support three-point calibration											
	Multi-functional Input Terminal		5ch DC24V 8mA											
	Multi-functional Output Terminal		2 ch DC24V 50mA, 1 ch Relay output											
	Analog Output Voltage		1 ch dc 0~10V											
	Cooling Method		Forced Air Cooling											
	Environment Temperature		-10 ~ 45 °C											
	Environment Humidity		Below 90 RH(No condensation)											
	Protection Functions		Over current, over voltage, low voltage, over heating, and overload in Hybrid Servo Controller and over heating, overload, and abnormal speed in Hybrid Servo Motor.											
Actuation Oil	Working Medium		HL-HLP DIN51 524 Part1/2 R68,R46											
	Operation Temperature	°C	-20 to 100											
	Viscosity	@40 °C	67.83											
		@100 °C	8.62											
Miscellaneous			Safety, Reactor, and EMI filter are optional.											

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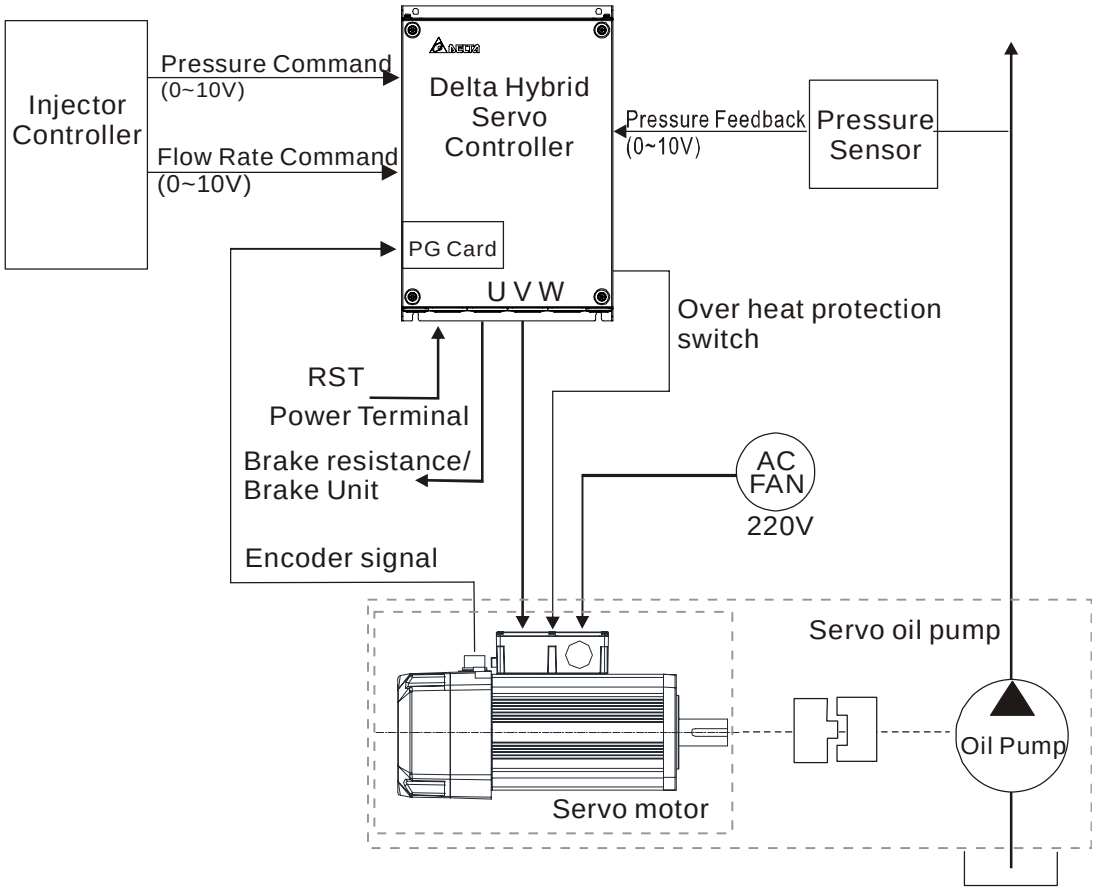
1-3 Introduction of Hybrid Energy System



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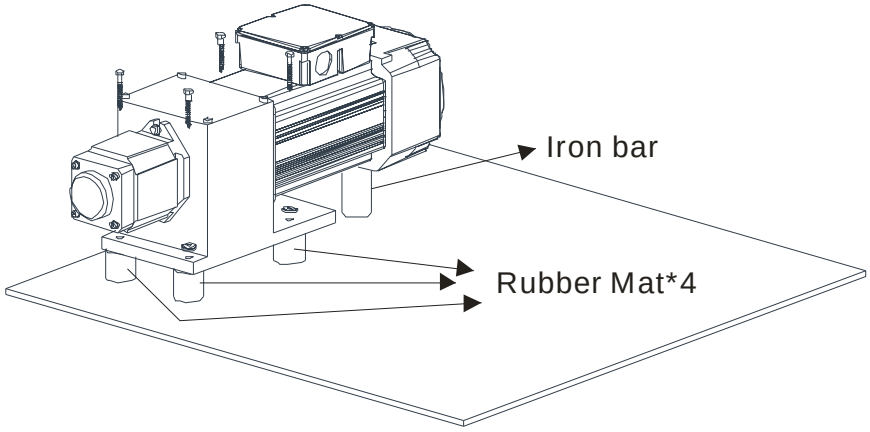
1-4 Installation

Servo Oil Pump

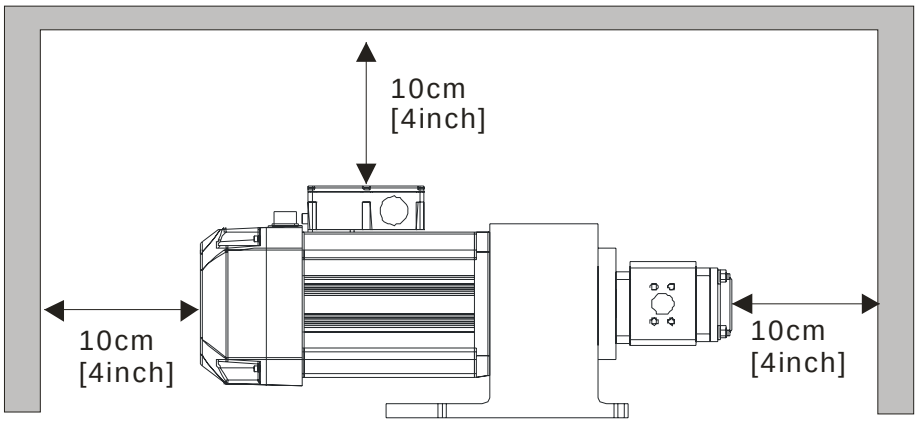
Please install the servo oil pump in an environment with the following conditions to ensure safe product operation:

Conditions of Operation Environment	Environment Temperature	0°C~ 40°C
	Relative Humidity	20%~90%, No condensation
	Oil Temperature	0°C~ 60°C (15°C~ 50°C is recommended)

The figure below shows that HES is installed on the machine. The screws must be secured to the rubber mat to fixate the servo oil pump. It is recommended to add iron bars as the support of the hybrid servo motor.



Installation Space



Installation Distance

Since heat is generated as the hybrid servo motor is running, certain space must be reserved to ensure good circulation of the cooling air as shown in the figure above.

When the hybrid servo motor is running, the temperature of the external cover will reach to about 100°C. Please do not touch it with hand to avoid burns.

NOTE

Please do not let any foreign objects such as fiber, paper pieces, wood chips or metal pieces to adhere to the cooling fan of the hybrid servo motor.

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Pipelines & Connections

- Remove all protection caps on the pump
- Choose suitable oil tube and connectors (Maximum intake flow rate 1m/s)

Recommended Specifications of intake oil tube		
Flow Rate(L/min)	Tube Diameter (inch)	Length (m)
63	Above 1.25	Within 1.5
80	Above 1.5	Within 1.5
100	Above 1.75	Within 1.5
125	Above 2	Within 1.5
160	Above 2.25	Within 1.5
200	Above 2.5	Within 1.5

- Absolute intake oil pressure: Maximum 2 bar
- Prior to assembly, the iron dusts in the connectors and oil tubes must be removed.
- The filter for the oil inlet must be above 150mesh.

NOTE

For safety, please install safety valve in the oil line loop.

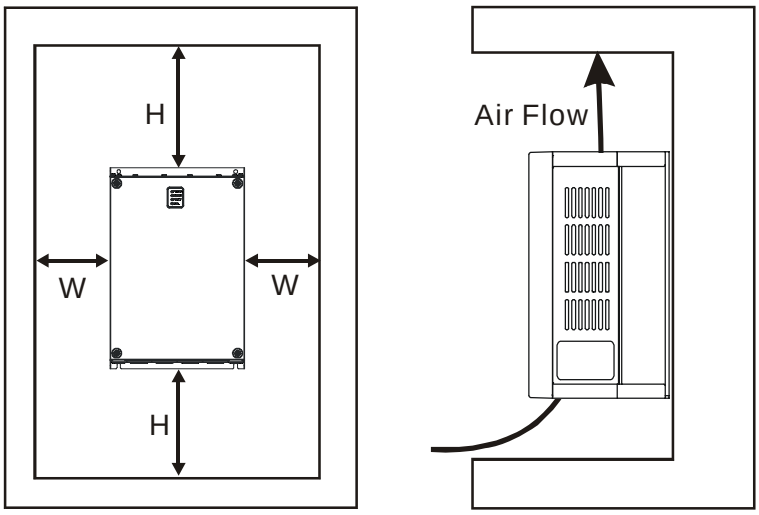
Do not add check valve to the oil outlet of the oil pump to avoid poor response of Hybrid Energy System.

Hybrid Servo Controller

Please install the Hybrid Servo Controller in an environment with the following conditions to ensure safe product operation:

Conditions of Operation Environment	Environment Temperature Relative Humidity Pressure Installation heights Vibration	-10°C~ +45°C <90%，No condensation 86 ~ 106 kPa <1000m <20Hz: 9.80 m/s^2 (1G) max; 20~50H:5.88 m/s^2 (0.6G) max
Conditions of Storage and Shipping Environment	Environment Temperature Relative Humidity Pressure Vibration	-20°C~ +60°C (-4°F ~ 140°F) <90%，No condensation 86 ~ 106 kPa <20Hz: 9.80 m/s^2 (1G) max; 20 ~ 50Hz: 5.88 m/s^2 (0.6G) max
Contamination Protection Grade	2nd Grade: suitable for factory environments with medium to low contamination	

Installation Space



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HP	**W** mm (inch)	**H** mm (inch)
7.5-20HP	75 (3)	175 (7)
25-75HP	75 (3)	200 (8)
100HP	75 (3)	250 (10)

- ☑ The Hybrid Servo Controller must be installed vertically with screws to sturdy structures. Do not install it upside down, tilted, or horizontally.
- ☑ Since heat is generated when Hybrid Servo Controller is running, good circulation of the cooling air must be provided as shown in the figure above. Certain space is reserved in the design to allow the heat generated to dissipate upwards. As a result, do not install the machine below any equipment that cannot stand excessive heat. If the machine is installed in the control plate, special care must be given to maintain good air flow for cooling so that the surrounding temperature of Hybrid Servo Controller won't exceed the regulated values. Do not install Hybrid Servo Controller in any closed box with poor air flow and cooling, which will lead to machine malfunction.
- ☑ As the Hybrid Servo Controller is running, the temperature of the cooling plate will change with the environment temperature and the load, with the maximum temperature reaching to about 90°C. Therefore, the backside of installation materials for Hybrid Servo Controller must be able to sustain high temperature.
- ☑ When multiple Servo Controllers are installed in one single control plate, it is recommended to install them with laterally to avoid heat interference among each other. If stacking installation is needed, spacers must be installed to minimize the effect of the heat from the lower machine on the upper machine.

NOTE

Do not add check valve to the oil outlet of the oil pump to avoid poor response of Hybrid Energy System.

The product should be installed in a control plate made of inflammable materials such as metal to avoid the risk of fire.

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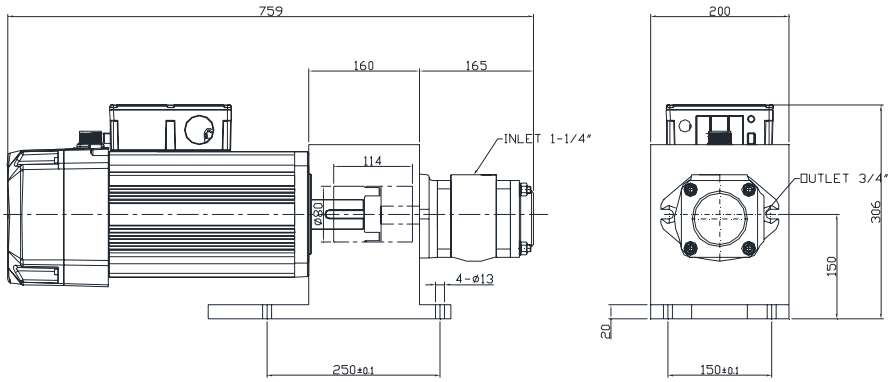
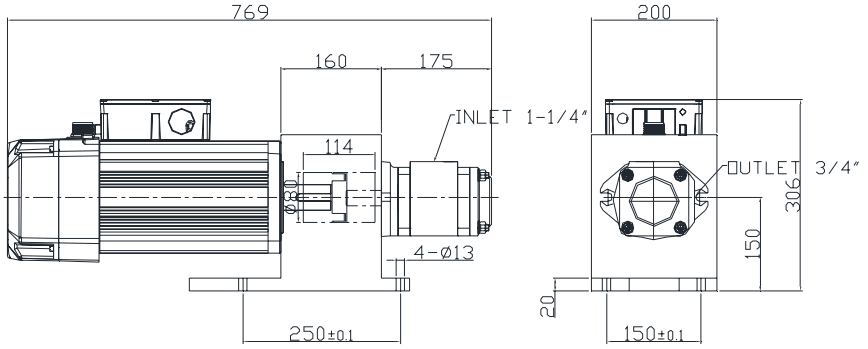
1-5 Dimensions

Servo Oil Pump

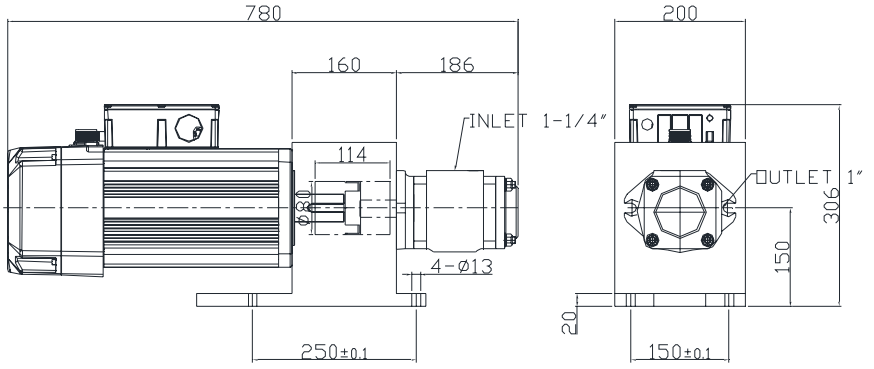
- HES063H23A, HES063G43A, HES063H43A,



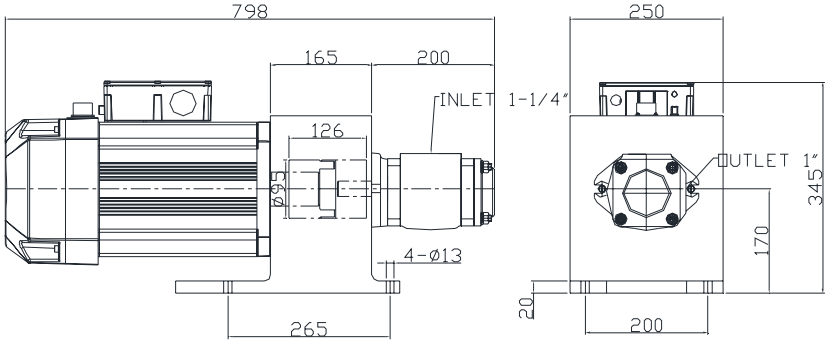
- HES080G23A, HES080H23A, HES080G43A, HES080H43A



- HES100G23A, HES100H23A, HES100G43A, HES100H43A



- HES125G23A, HES125H23A, HES125G43A, HES125H43A



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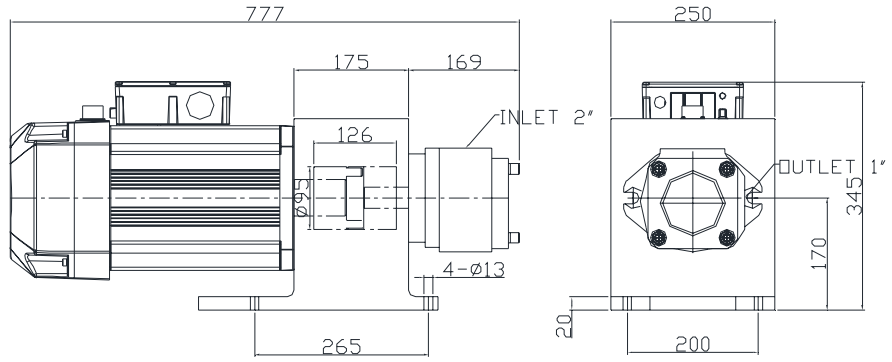
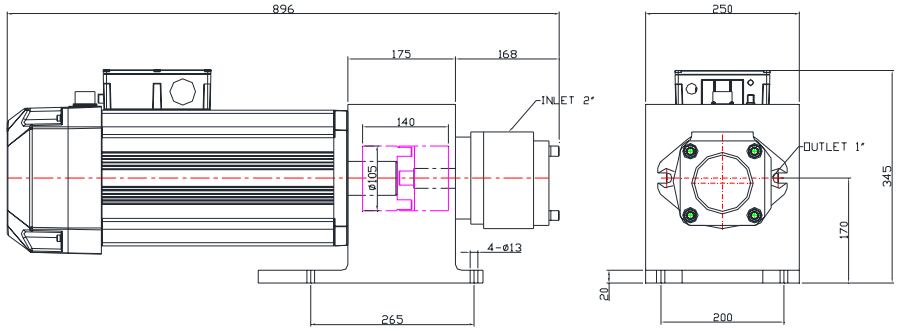
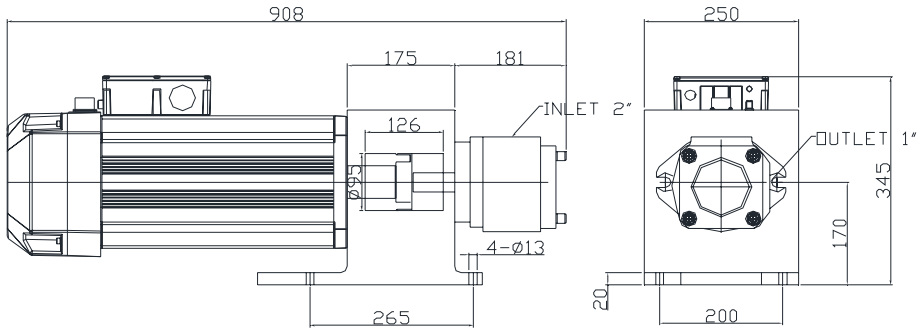
- HES160G23A, HES160G43A, HES160H43A



- HES160H43A



- HES200G43A



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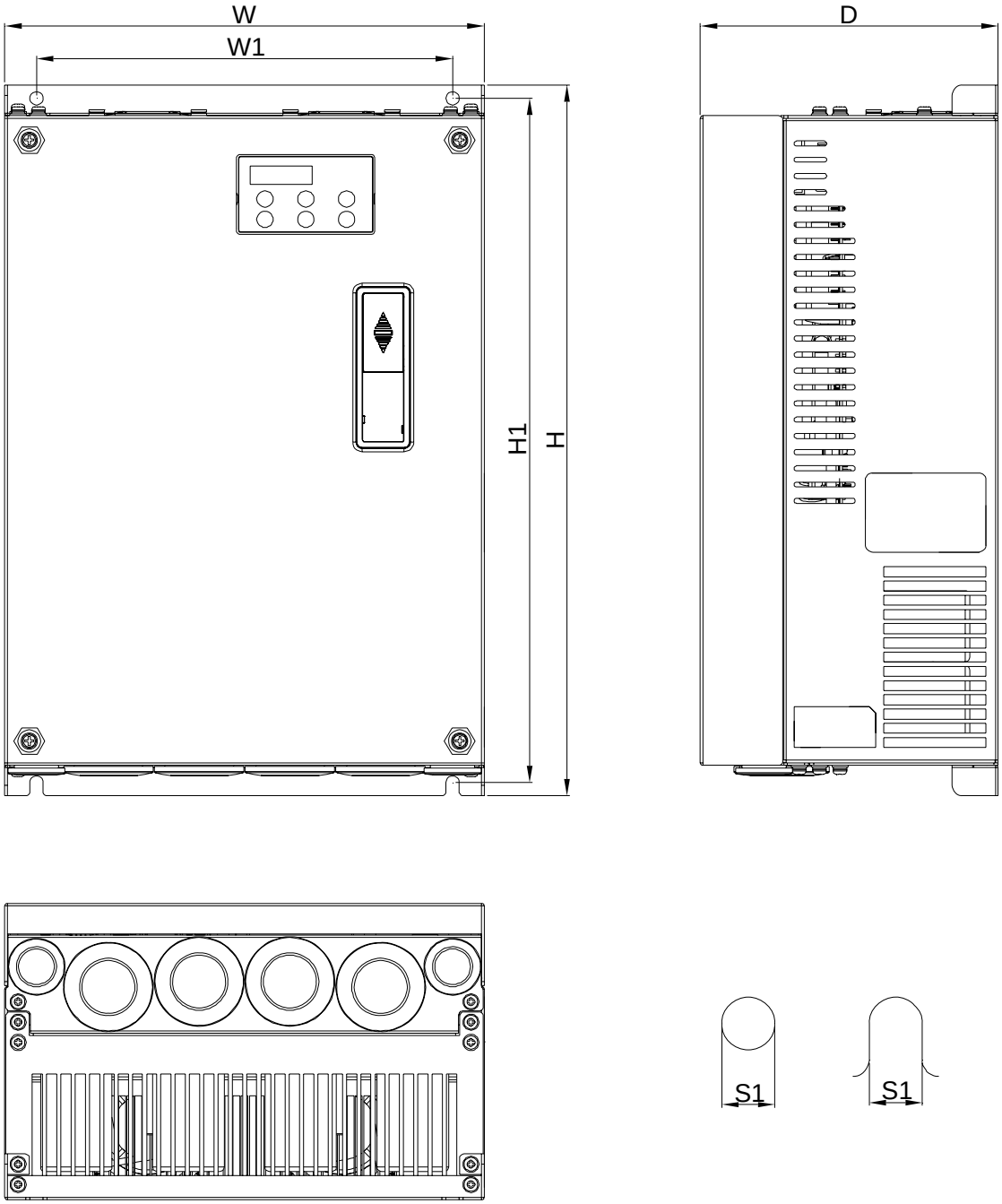
Hybrid Servo Controller

Frame C



Unit: mm[inch]

Frame	W	W1	H	H1	H2	H3	D	Ø	Ø1	Ø2	Ø3
C	235 [9.25]	204 [8.03]	350 [13.78]	337 [13.27]	320 [12.60]	-	136 [5.35]	6.5 [0.26]	-	34 [1.34]	22 [0.87]

NOTE

Frame C: VFD110VL23A/43A-J,

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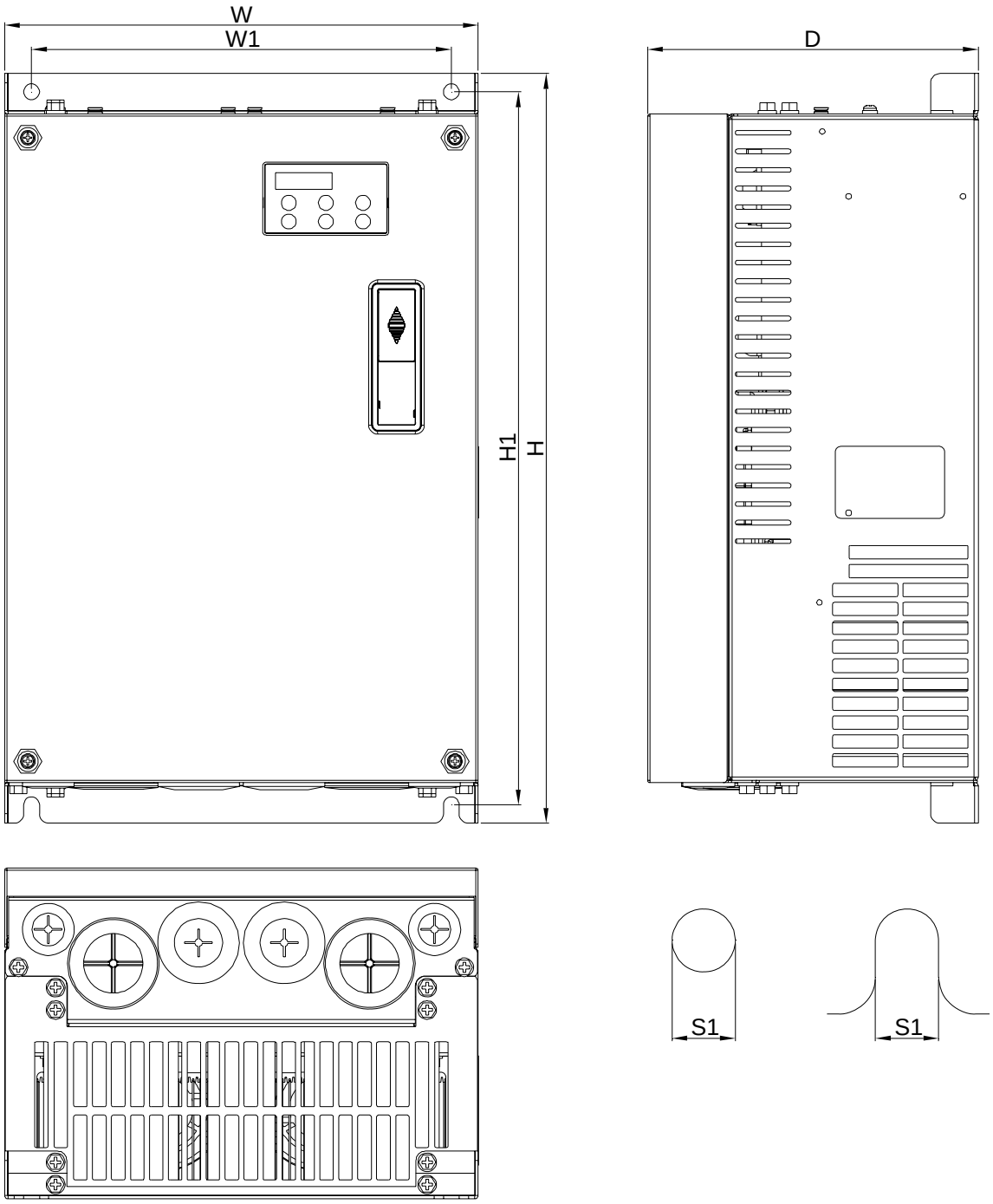
Frame D



Unit: mm[inch]

Frame	W	W1	H	H1	H2	H3	D	Ø	Ø1	Ø2	Ø3
D	255.0 [10.04]	226.0 [8.90]	403.8 [15.90]	384.0 [15.12]	360.0 [14.17]	21.9 [0.86]	168.0 [6.61]	8.5 [0.33]	44 [1.73]	34 [1.34]	22 [0.87]

NOTE

Frame D: VFD150VL23A/43A-J, VFD185VL23A/43A-J, VFD220VL23A/43A-J,

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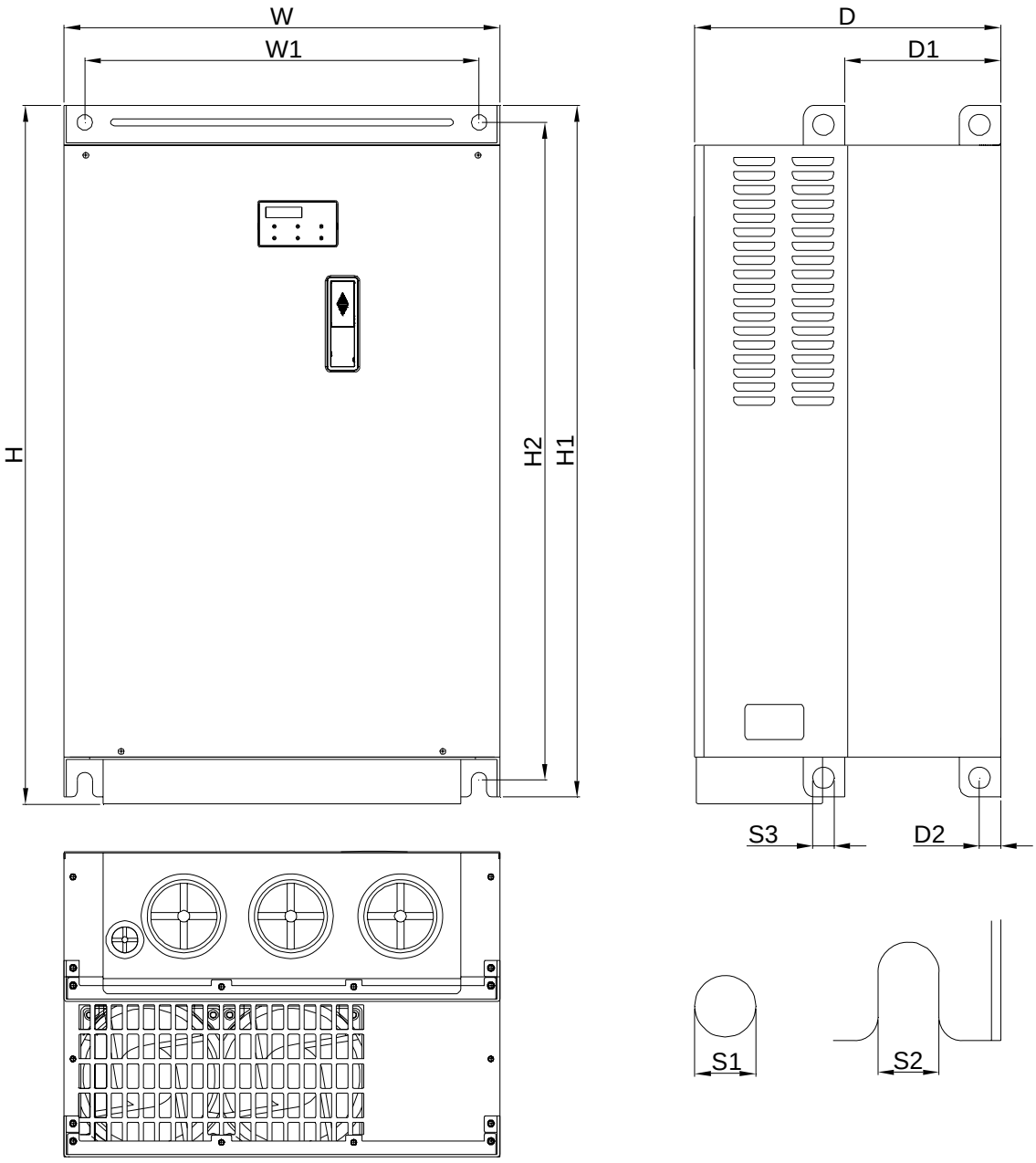
Frame E



Unit: mm[inch]

Frame	W	W1	H	H1	H2	D	D1	D2	S1	S2	S3
E1	370.0 [14.57]	335.0 [13.19]	-	589.0 [23.19]	560.0 [22.05]	260.0 [10.24]	132.5 [5.22]	18.0 [0.71]	13.0 [0.51]	13.0 [0.51]	18.0 [0.71]
E2	370.0 [14.57]	335.0 [13.19]	595.0 [23.43]	589.0 [23.19]	560.0 [22.05]	260.0 [10.24]	132.5 [5.22]	18.0 [0.71]	13.0 [0.51]	13.0 [0.51]	18.0 [0.71]

NOTE

Frame E1: VFD300VL43A-J, VFD370VL43A-J, VFD450VL43A-J,

Frame E2: VFD300VL23A-J, VFD370VL23A-J,

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Chapter 2 Wiring

2-1 Wiring
2-2 Wiring of Servo Oil Pump
2-3 Descriptions of Main circuit Terminals
2-4 Descriptions of Control Loop Terminals

Upon opening the top cover of the Hybrid Servo Controller and reveal the wiring terminal bus, check if the terminals of each Main circuit circuit and control loop circuit are labeled clearly. Pay attention to the following wiring descriptions to avoid any incorrect connection.

- ☑ The Main circuit power terminals R/L1, S/L2, and T/L3 of the Hybrid Servo Controller are for power input. If the power supply is connected by accident to other terminals, the Hybrid Servo Controller will be damaged. In addition, it is necessary to verify that the voltage/current rating of power supply is within the numbers listed on the name plate.
- ☑ The ground terminal must be grounded well, which can avoid being stricken by lightning or occurrence of electrocution and minimize interference by noise.
- ☑ The screw between each connection terminal and the wire must be tightened securely to avoid sparking by getting loose from vibration.

DANGER	☑ If the wiring is to be changed, first step is to turn off the power of the Hybrid Servo Controller, for it takes time for the DC filter capacitor in the internal loop to completely discharge. To avoid any danger, the customer can wait for the charging indicator (READY light) to be of completely and measure the voltage with a DC voltmeter. Make sure the measured voltage is below the safety value of 25Vdc before starting the wiring task. If the user fails to let the Hybrid Servo Controller completely discharge, residual voltage will build up internally, which will cause short circuit and spark if wiring is conducted. Therefore, it is recommended that the user should only conduct the wiring when there is no voltage to ensure his/her safety. ☑ The wiring task must be conducted only by professional personnel. Make sure that the power is off before starting to avoid incidence such as electrocution.
CAUTION	☑ During wiring, please follow the requirements of the electrical regulations to select proper gauges and conduct wiring accordingly to ensure safety. ☑ Check the following items after finishing the wiring: 1. Are all connections correct? 2. No loose wires? 3. No short-circuits between terminals or to ground?

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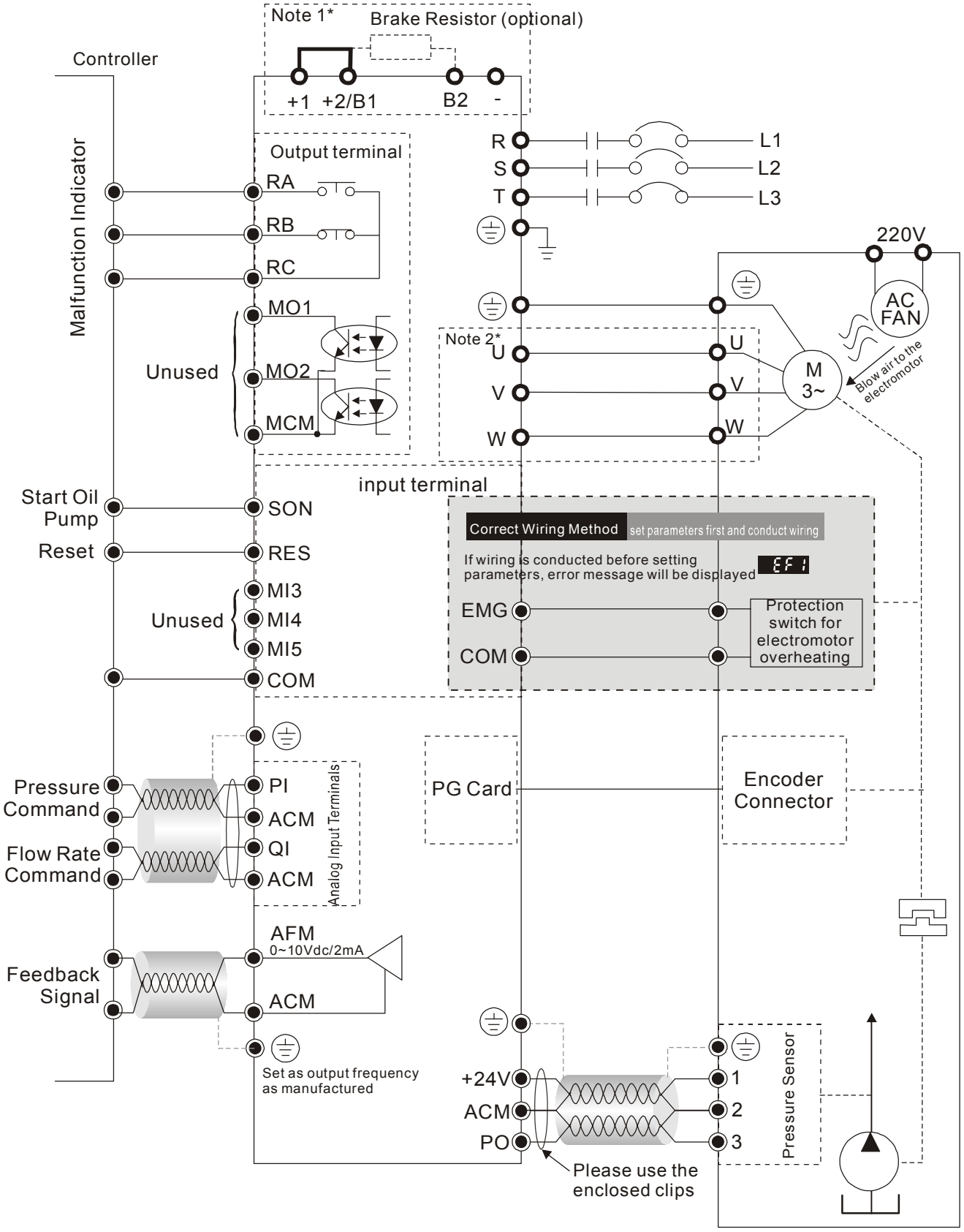
2-1 Wiring

The wiring of the hybrid energy system consists of that for the servo oil pump and that for the Hybrid Servo Controller. The user must follow the wiring loop below for all wire connections.

Standard Wiring Diagram



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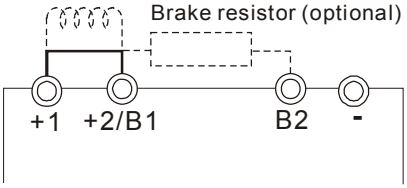
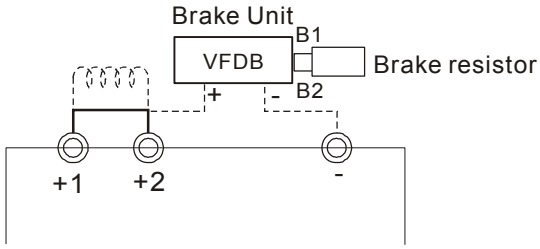
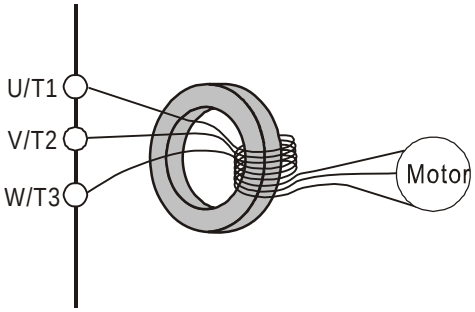
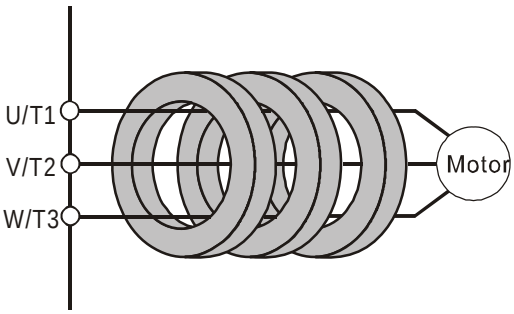
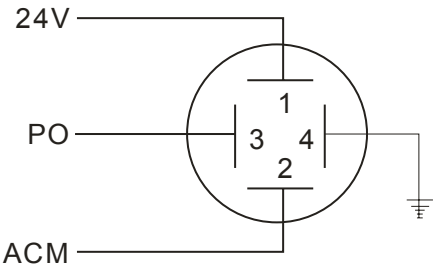
Note 1*

For models with power rating below 22kW (including the 22kW model, with built-in brake unit)	For models with power rating above 30kW (including the 30kW model, brake unit is required)
	

Note 2*

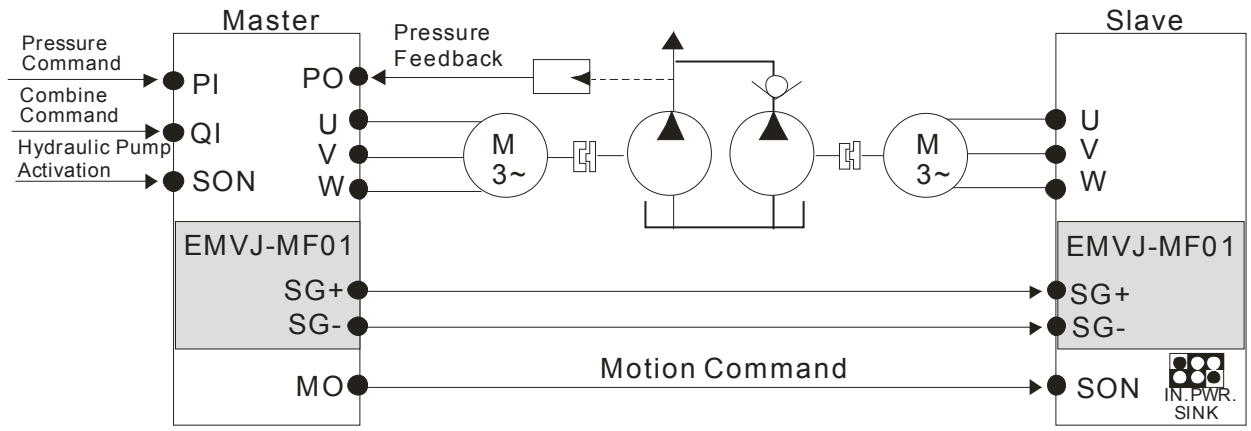
For models with power rating below 22kW (including 22kW) (it is recommended to wrap the output wire around the zero-phase reactor for over three times before connecting it to the motor)	For models with power rating below 30kW (including 30kW)
	

Wiring Diagram of Pressure Sensor

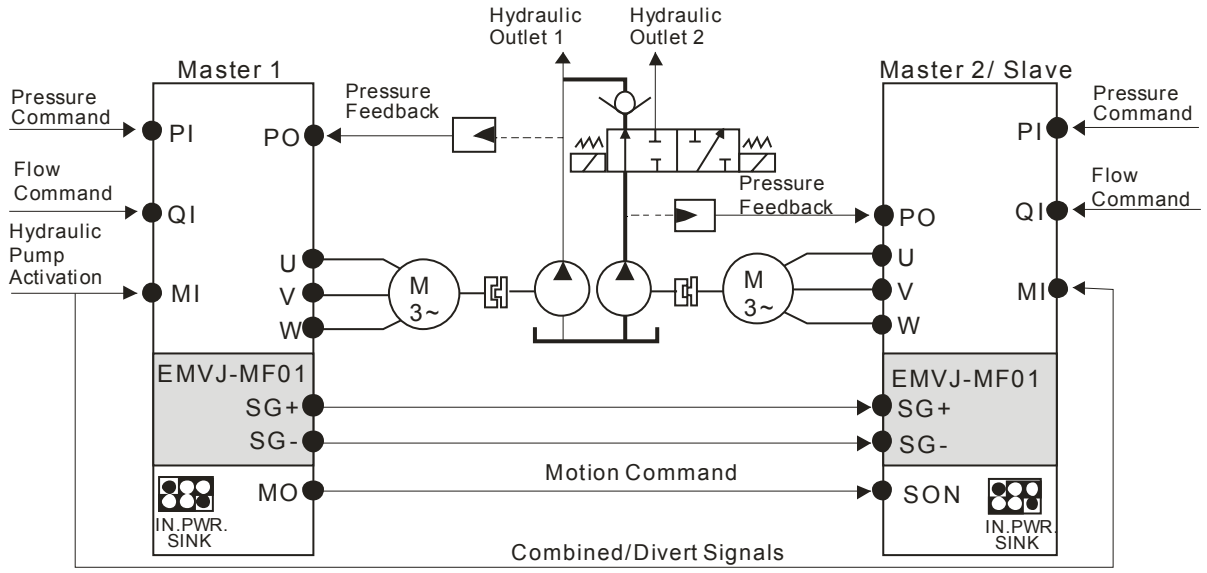
 Connector of Pressure Sensor	

Multi-pump Operation Mode

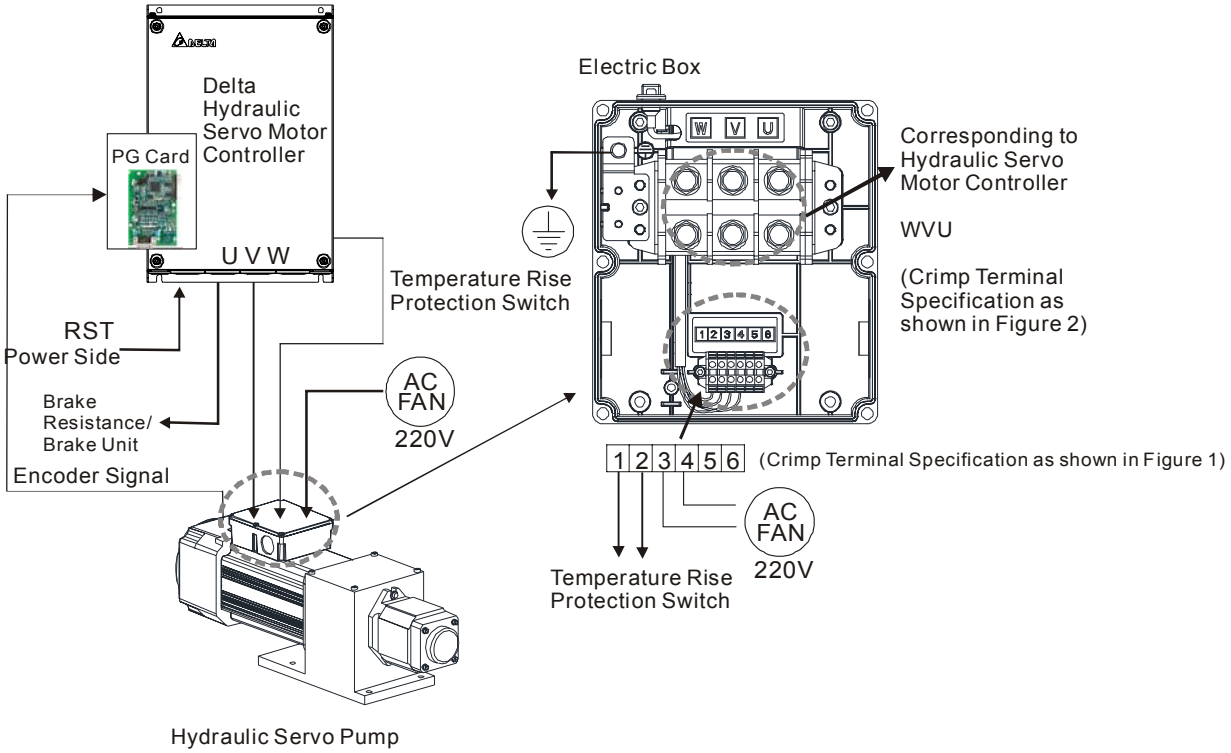
Combined Mode



Combined-Divert Mode



2-2 Wiring of Servo oil Pump



Crimp Terminals

Terminal Torque: 82kg-m (71in-lbf)

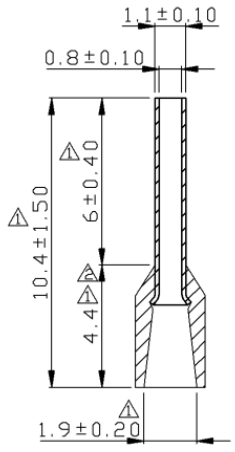


Figure 1

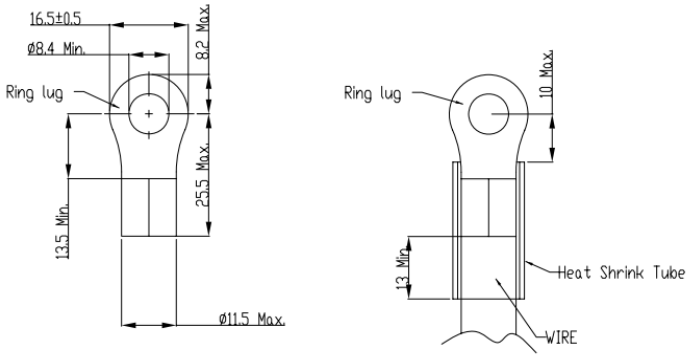
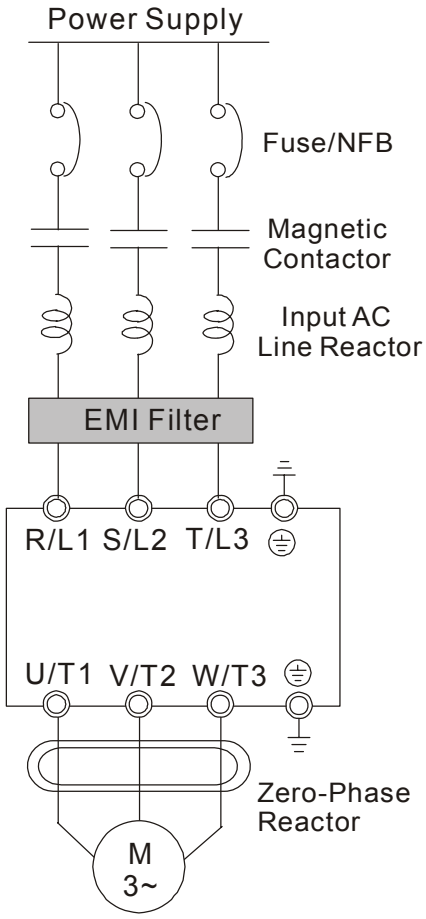


Figure 2

External Wiring of Hybrid Servo Controller



Power Supply	Please follow the power rating listed in the user's manual (chapter 1)
Fuse/NFB (Optional)	A larger current may be generated when the power is turned on. Please refer to Appendix B-1 to select suitable non-fused switch or fuse.
Magnetic Contactor	Turning on/off the side electromagnetic contactor can start/stop the hybrid servo controller. However, frequent switching may lead to malfunction. It is advised not to turn on/off the hybrid servo controller for more than 1 time/hour.
Input AC Line Reactor (Optional)	When the output capacity exceeds 1000kVA, it is recommended to add an AC reactor to improve the power factor, with the wiring distance within 10m. Please refer to Appendix B-2 for details.
Zero-Phase Reactor	This is to reduce the radiation interference, especially in places with audio devices. It can also reduce the interferences at the input and output sides. Please refer to appendix B-2 for details. The effective range is from AM band to 10MHz.
EMI Filter	It can be used to reduce electromagnetic interference. Please refer to Appendix B-5 for details.

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2-3 Main Circuit

Terminal Label	Description
R/L1, S/L2, T/L3	AC line input terminals
U/T1, V/T2, W/T3	Output of Hybrid Servo Controller, connected to hybrid servo motor
+1, +2/B1	For power improvement of the connection terminal of DC reactor. Please remove the shorting plate in installation (DC reactors are built-in in models with power ≧22KW)
+2/B1, B2	Connection terminal of brake resistor. Please follow the selection table to purchase suitable ones.
⏚	Ground terminal. Please use type-3 grounding for 230V series and special-type grounding for 460V series according to the electrical regulation.

CAUTION

- ☑ The wiring for the Main circuit must be isolated from that for the control loop to avoid malfunction.
- ☑ Please use isolation wires for control wiring as much as possible. Do not expose the section where the isolation mesh is stripped before the terminal.
- ☑ Please use isolation wire or wire tube for power supply wiring and ground the isolation layer or both ends of wire tube.
- ☑ Usually the control wire does not have good insulation. If the insulation is broken for any reason, high voltage may enter the control circuit (control board) and cause circuit damage, equipment accident, and danger to operation personnel.
- ☑ Noise interferences exist between the Hybrid Servo Controller, hybrid servo motor, and their wirings. Check if the pressure sensor and associated equipments for any malfunction to avoid accidents.
- ☑ The output terminals of the Hybrid Servo Controller must be connected to the hybrid servo motor with the correct order of phases.
- ☑ When the wiring between the Hybrid Servo Controller and hybrid servo motor is very long, it may cause tripping of hybrid servo motor from over current due to large high-frequency current generated by the stray capacitance between wires. In addition, when the leakage current increases, the precision of the current value becomes poor. In such case, an AC reactor must be connected to the output side.
- ☑ The ground wire of the Hybrid Servo Controller cannot be shared with other large current load such as electric welding tool. It has to be grounded separately.
- ☑ For safety issue and noise reduction, type-3 grounding (⏚) is used for 230V series while special-type grounding (⏚) is used for 460V series (ground resistance below 10Ω) This is based on Line 27, Section 8, and Chapter 1 of the electrical regulations.

Voltage Series	Type of Grounding Work	Ground Resistance
230V	Type-3 work	Below 100Ω
460V	Special-Type work	Below 10Ω

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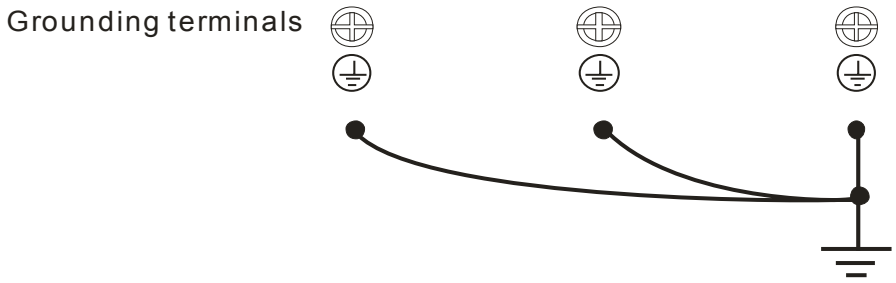
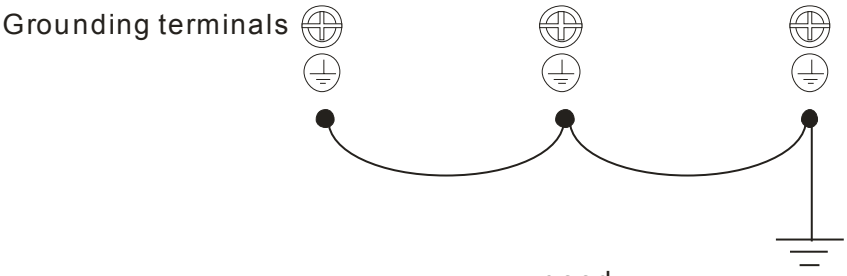
☑ To avoid lightning strike and incidence of electrocution, the external metal ground wire for the electrical equipments must be thick and short and connected to the ground terminal of the Hybrid servo driver system.

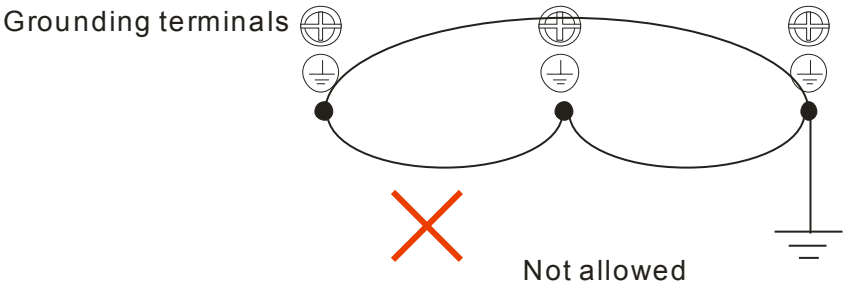
☑ When multiple Hybrid Servo Controllers are installed together, all of them must be directly connected to a common ground terminal. Please refer to the figure below to make sure there is no ground loop.



Excellent



good



Not allowed

Mains power terminals (R/L1, S/L2, T/L3):

☑ Connect these terminals (R/L1, S/L2, T/L3) via a non-fuse breaker or earth leakage breaker to 3-phase AC power (some models to 1-phase AC power) for circuit protection. It is unnecessary to consider phase-sequence.

☑ The wire between the three-phase AC input power supply and the Main circuit terminals (R/L1, S/L2, and T/L3) must be connected to a non-fused switch.

☑ Please make sure to fasten the screw of the main circuit terminals to prevent sparks which is made by the loose screws due to vibration.

☑ Verify the voltage of power supply and the associated maximum available current. Please refer to Chapter 1 Descriptions of Specifications.

☑ If the Hybrid Servo Controller is equipped with a leakage circuit breaker for leakage protection, please select the circuit breaker that has a sensing current above 200mA and action time over 0.1 second to avoid malfunction.

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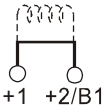
☑ Please use isolation wire or wire tube for power supply wiring and ground the isolation layer or both ends of wire tube.

Output terminals for main circuit (U, V, W) :

☑ The output side of Hybrid Servo Controller cannot be connected with advance phase capacitor, surge absorber, advance phase capacitor, or L-C and R-C filters.

Terminals [+1, +2] for connecting DC reactor, terminals [+1, +2/B1] for connecting brake resistor:

☑ These terminals are used to improve the power factor of DC reactor. There are shorting plates on them when they leave the factory. Remove the shorting plates before connecting the DC reactor.



Shorting Plate of DC Reactor

☑ For models with power ＞22kW, there is no driver loop for brake resistor inside. To increase the brake capability, please use an external brake unit and brake resistor (both are optional).

☑ Never short [B2] or [-] to [＋2/B1], which will damage the Hybrid Servo Controller.

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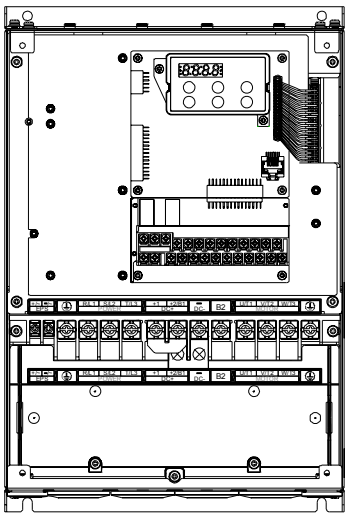
Main Circuit Terminals

Frame C



Main circuit terminals:
R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, ⏚, +1, +2/B1, -, B2

Model	Wire Gauge	Torque
VFD055VL23A-J VFD110VL43A-J	10-6 AWG. (5.3-13.3mm^2)	30kgf-cm (26in-lbf)
VFD055VL43A-J VFD075VL43A-J	12-6 AWG. (3.3-13.3mm^2)	
VFD110VL23A-J	6 AWG. (13.3mm^2)	
VFD075VL23A-J	8-6 AWG. (8.4-13.3mm^2)	

Wire type: Stranded copper only, 75°C
Figure 1 shows the terminal specification.
Figure 2 shows the specification of insulated heat shrink tubing that comply with UL (600V, YDPU2).

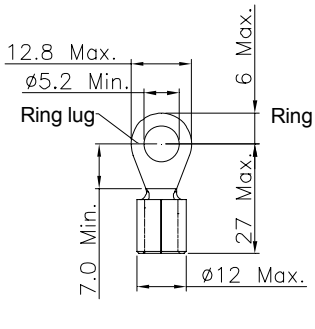
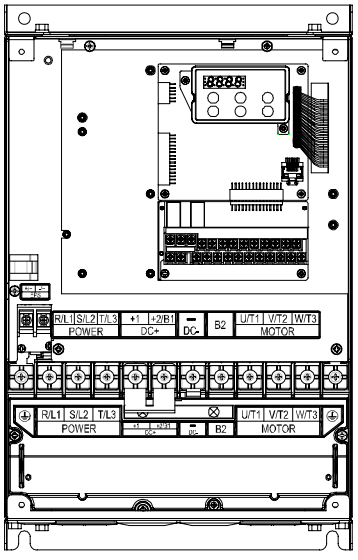


Figure 1 Figure 2

Frame D



Main circuit terminals:
R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, ⏚, +1, +2, -

Model	Wire Gauge	Torque
VFD150VL43A-J VFD185VL43A-J	8-2 AWG. (8.4-33.6mm^2)	50Kgf-cm (43.4 lbf-in)
VFD150VL23A-J	4-2 AWG. (21.1-33.6mm^2)	
VFD185VL23A-J	3-2 AWG. (26.7-33.6mm^2)	
VFD220VL43A-J	6-2AWG (13.3-33.6mm^2)	
VFD220VL23A-J	3-2AWG (26.7-33.6mm^2)	

Wire type: Stranded copper only，75°C
Figure 1 shows the terminal specification.
Figure 2 shows the specification of insulated heat shrink tubing that comply with UL (600V, YDPU2).

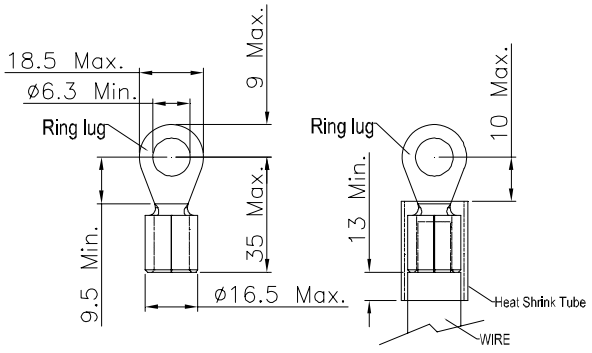
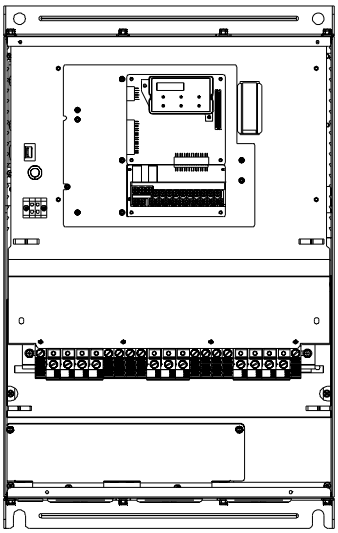


Figure 1 Figure 2

Frame E



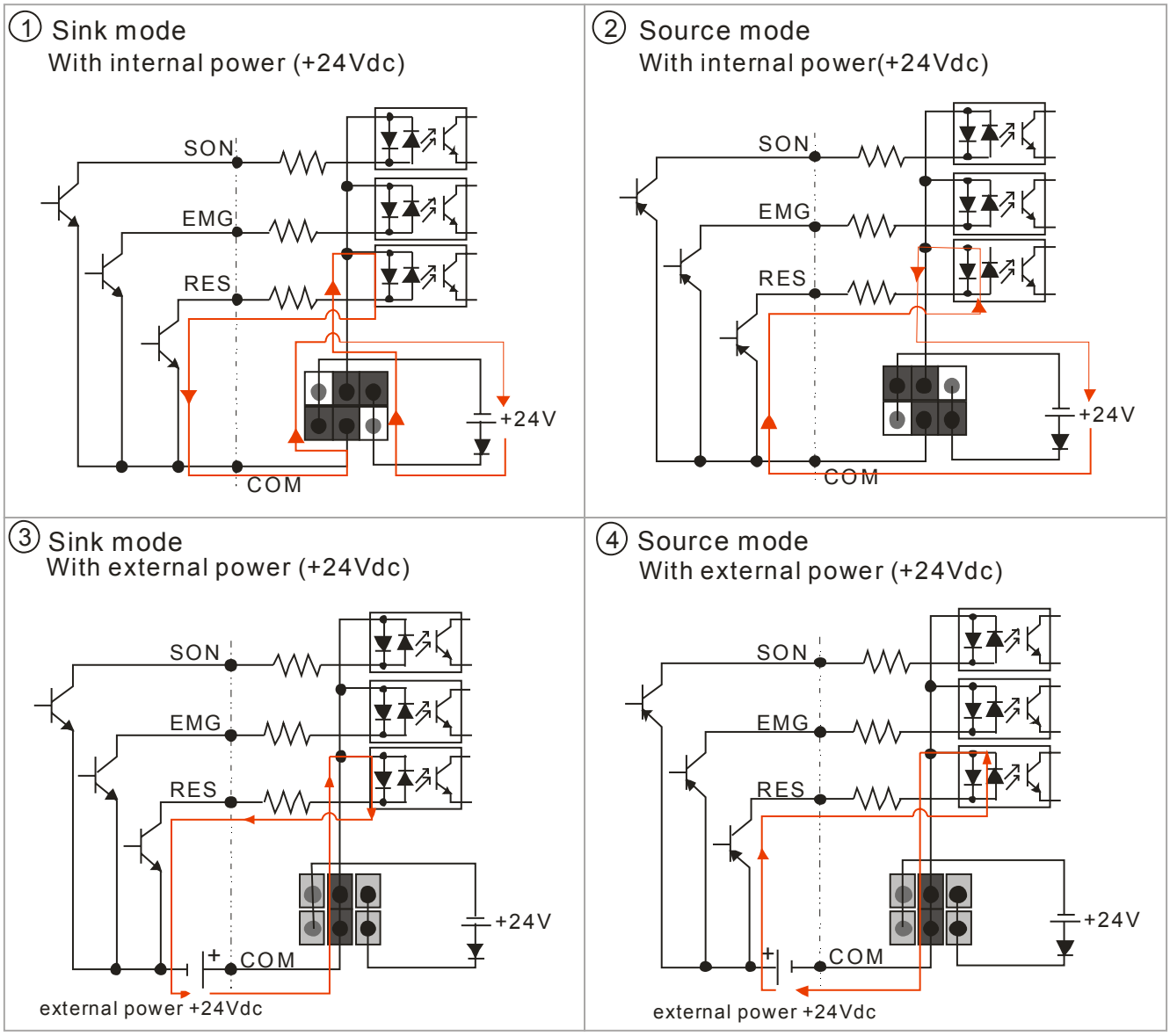
Main circuit terminals:
R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, ⏚, +1, +2, -

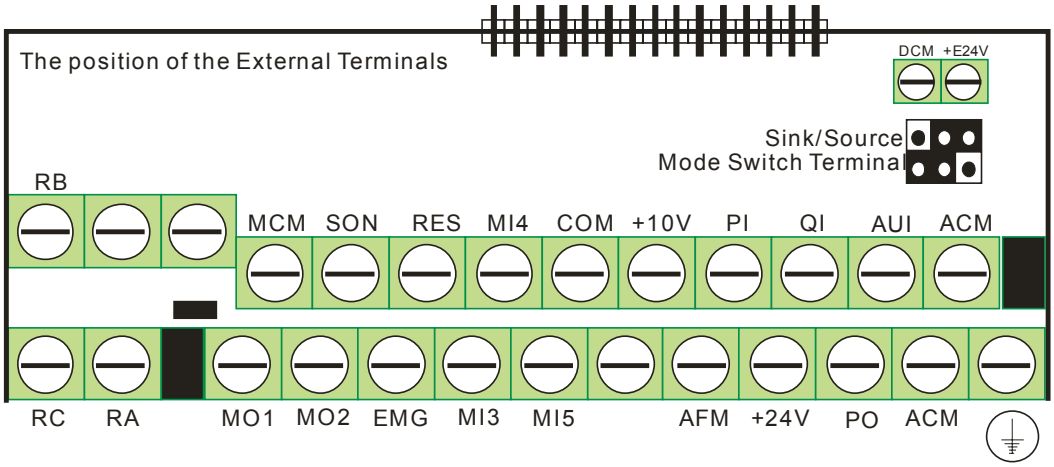
Model	Wire Gauge	Torque
VFD300VL43A-J	4-2 AWG. (21.2-33.6mm^2)	57kgf-cm (49in-lbf)
VFD370VL43A-J		
VFD450VL43A-J		
VFD300VL23A-J		200kgf-cm (173in-lbf)
VFD370VL23A-J		
VFD550VL43A-J		
VFD750VL43A-J		

Wire type
Stranded copper only，75°C

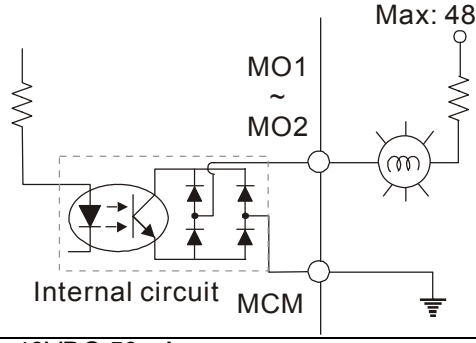
2-4 Control Terminals

Description of SINK（NPN）/SOURCE（PNP）Mode Switching Terminal




The position of the External Terminals
DCM +E24V
Sink/Source
Mode Switch Terminal
RB
MCM SON RES MI4 COM +10V PI QI AUI ACM
RC RA MO1 MO2 EMG MI3 MI5 AFM +24V PO ACM

Frame	Torque		Wire Gauge
C, D, E	8 kgf-com (6.9 in-lbf)		22-14 AWG (0.3-2.1mm^2)
	Terminal: 0V/24V	1.6 kgf-com(1.4 in-lbf)	30-16 AWG (0.051-1.3mm^2)

Terminal	Function	Factory Setting (NPN mode)
SON	Run-Stop	Between terminals SON-DCM: conducting (ON)；run: open circuit (OFF), Stop
EMG	Abnormal input from outside	Abnormal input from outside
RES	Reset	reset
MI3	Multiple Function Input: Option 3	No function is set for default setting When conducting (ON), input voltage is 24Vdc (Max:30Vdc) and output impedance is 3.75kΩ；In open circuit (OFF), the allowable leakage current is 10μA
MI4	Multiple Function Input: Option 4	
MI5	Multiple Function Input: Option 5	
COM	Common terminal of digital control signals (Sink)	Common terminal of multiple function input terminals
+E24V	Common terminal of digital control signals (Source)	+24V 80mA
DCM	Common terminal of digital control signals (Sink)	Common terminal of multiple function input terminals
RA	Malfunctioning abnormal connection 1 (Relay always open a)	Resistive Load: 5A(N.O.)/3A(N.C.) 240VAC 5A(N.O.)/3A(N.C.) 24VDC Inductive Load: 1.5A(N.O.)/0.5A(N.C.) 240VAC 1.5A(N.O.)/0.5A(N.C.) 24VDC
RB	Malfunctioning abnormal connection 1 (Relay always closed b)	
RC	Multi-function Relay Common	
MO1	Multi-function Output 1 (Photocoupler)	Hybrid Servo Controller outputs various types of monitoring signals with the transistor operating in open collector mode. Max: 48Vdc/50mA 
MO2	Multi-function Output 2 (Photocoupler)	
MCM	Multi-function Output Common (Photocoupler)	Max. 48VDC 50mA

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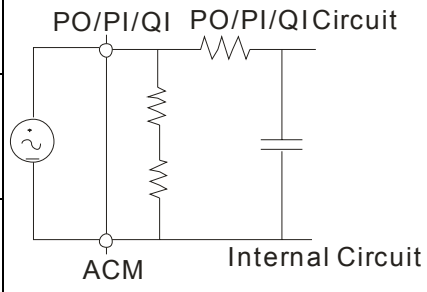
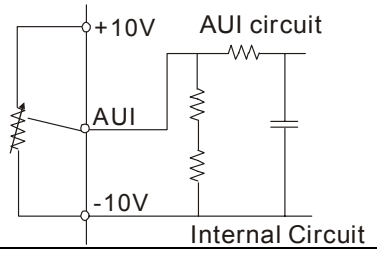
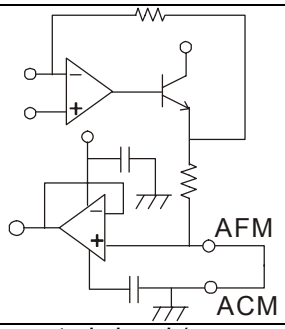
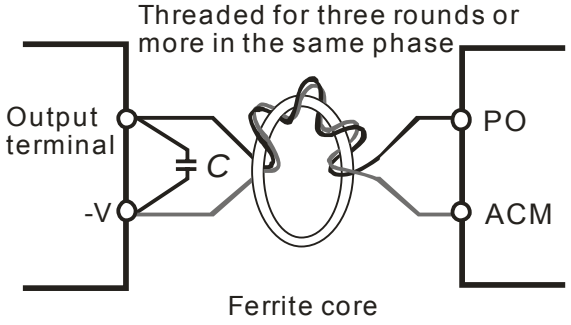
Terminal	Function	Factory Setting (NPN mode)
PO	PO/PI/QI circuit 	Pressure Feedback Impedance:200kΩ Resolution:12 bits Range:0 ~ 10V=0~maximum Pressure Feedback value(Pr.00-08)
PI		Pressure Command Impedance:200kΩ Resolution:12 bits Range:0 ~ 10V=0~maximum pressure command value(Pr.00-07)
QI		Flow Rate Command Impedance:200kΩ Resolution:12 bits Range:0 ~ 10V=0~maxium flow rate
AUI	Analog Voltage 	Impedance:11.3kΩ Resolution:12 bits Range:-10~+10VDC
+10V	Configuration Voltage	Power supply for analog configuration +10Vdc 20mA (variable resistor 3~5kΩ)
+24V	Power supply terminal of pressure sensor	Configuration power supply for pressure sensor +24Vdc 100mA
AFM		Impedance:16.9kΩ (voltage output) Output Current: 20mA max Resolution: 0~10V corresponds to maximum operation frequency Range: 0~10V Function Setting: Pr.00-05
ACM	Analog control signal (common)	Common for ACI, AUI1, AUI2

*Control signal wiring size: 18 AWG (0.75 mm^2) with shielded wire.

Analog Input Terminals (PO, PI, QI, AUI, ACM)

- ☑ The maximum input voltage of PI, PO, and QI cannot exceed +12V and no more than +/-12V for AUI. Otherwise, the analog input function may become ineffective.
- ☑ Analog input signals are easily affected by external noise. Use shielded wiring and keep it as short as possible (<20m) with proper grounding. If the noise is inductive, connecting the shield to terminal ACM can bring improvement.
- ☑ The interference generated by the Hybrid Servo Controller can cause the pressure sensor to malfunction. IN this case, a capacitor and a ferrite core can be connected to the pressure sensor side, as shown in the figure below:



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Transistor outputs (MO1, MO2, MCM)

☑ Make sure to connect the digital outputs to the right polarity.

☑ When connecting a relay to the digital outputs connect a surge absorber across the coil and check the polarity.

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Chapter 3 Start Up

3-1 Digital Keypad KPVJ-LE01
3-2 Auto-tuning Operations
3-3 Explanations for the Auto-tuning Steps

CAUTION	☑ Please verify again before operation that the wiring is done correctly, especially that the output terminals U/T1, V/T2, and W/T3 of the Hybrid Servo Controller cannot have any power input. Make sure that the ground terminal ⏚ is connected correctly. ☑ Do NOT operate the AC motor drive with humid hands. ☑ Check for loose terminals, connectors or screws. ☑ Make sure that the front cover is well installed before applying power.
WARNING	☑ In case of abnormal operation of the Hybrid Servo Controller and the associated servo motor, stop the operation immediately and refer to “Troubleshooting” to check the causes of anomalies. After the output of the Hybrid Servo Controller is stopped, when the power terminals L1/R, L2/S, and L3/T of the main circuit are still connected, touching the output terminals U/T1, V/T2, and W/T3 of the Hybrid Servo Controller may lead to electric shock.

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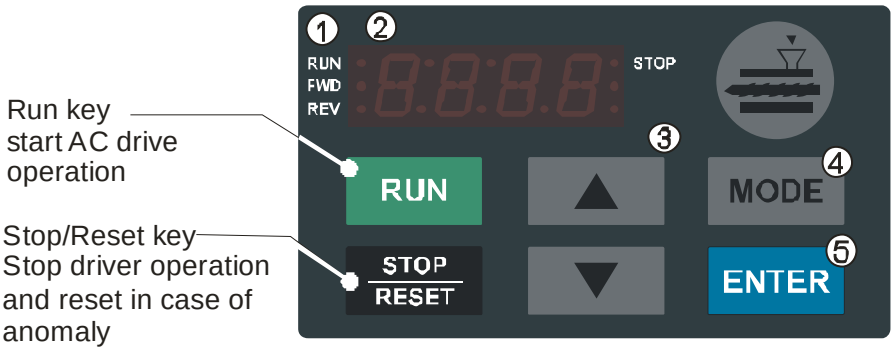
3-1 Digital Keypad (KPVJ-LE01)

Description of the Digital Keypad KPVJ-LE01



❶ Status Display
Display the driver's current status.

❷ LED Display
Indicates frequency, voltage, current, user defined units and etc.

❸ UP and DOWN Key
Set the parameter number and changes the numerical data, such as Master Frequenc

❹ MODE
Change between different display mode.

❺ ENTER
Used to enter/modify programming parameters.

Descriptions of Function Display Items

Display **Message**	Descriptions
RUN FWD REV STOP F60.0	Displays theAc driver Master frequency
RUN FWD REV STOP H50.0	Displays the actual output frequency at terminals U/T1, V/T2, and W/T3.
RUN FWD REV STOP U180	User defined unit (where U = F x Pr.00.04)
RUN FWD REV STOP A 5.0	Displays the output current at terminals U/T1, V/T2, and W/T3.
RUN FWD REV STOP Frd	Displays the AC motor drive forward run status.
RUN FWD REV STOP rEv	Displays the AC motor drive reverse run status.
RUN FWD REV STOP 01.00	Displays the parameter item
RUN FWD REV STOP 10	Displays the actual stored value of the selected parameter.

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Display **Message**	Descriptions
	External Fault.
	Display “End” for approximately 1 second if input has been accepted by pressing ENTER key. After a parameter value has been set, the new value is automatically stored in memory. To modify an entry, use the ▲ and ▼ keys.
	Display “Err”, if the input is invalid.

How to Operate the Digital Keypad

Setting Mode

START

GO START

NOTE: In the selection mode, press ENTER to set the parameters.

Setting parameters

Success to set parameter.

Input data error

NOTE :In the parameter setting mode, you can press ENTER to return the selecting mode.

To shift data

START

Setting direction (When operation source is digital keypad)

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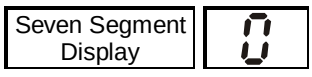
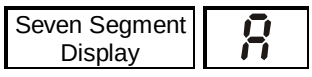
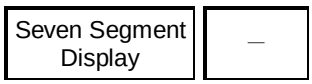
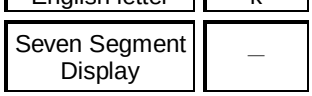
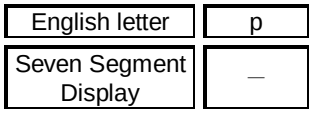
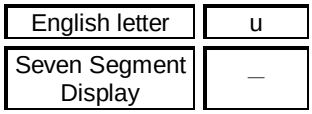
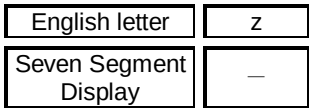
Reference Table for the 7-segment LED Display of the Digital Keypad

Number	0	1	2	3	4	5	6	7	8	9
Seven Segment Display										
English letter	A	a	B	C	c	D	d	E	e	F
Seven Segment Display										
English letter	f	G	g	H	h	I	i	J	j	K
Seven Segment Display										
English letter	k	L	l	M	m	N	n	O	o	P
Seven Segment Display										
English letter	p	Q	q	R	r	S	s	T	t	U
Seven Segment Display										
English letter	u	V	v	W	w	X	x	Y	y	Z
Seven Segment Display										
English letter	z									
Seven Segment Display										

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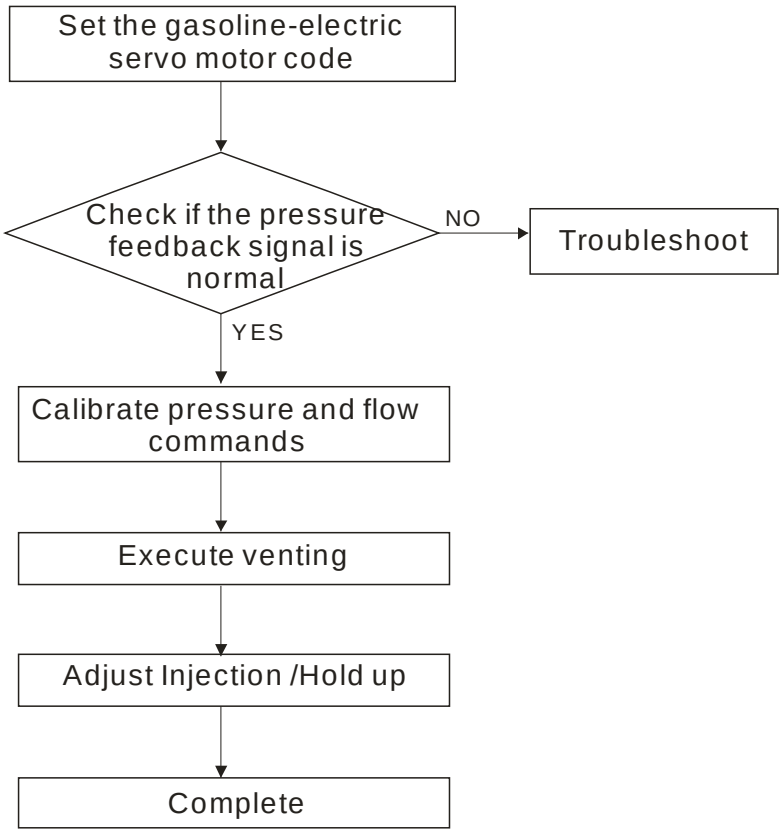
3-2 Auto-tuning Flow Chart



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3-3 Explanations for the Auto-tuning Steps

Operate the following steps with the digital operator (KPVJ-LE01/ KPV-CE01) or the VFD-Explorer monitor software

Prior to starting running, please verify again if the wiring is correct, especially that the output terminals U/T1, V/T2, and W/T3 of the Hybrid Servo Controller must correspond to the U, V, and W terminals of the gasoline-electric servo motor, respectively.

Step 1. Parameter Entry of Gasoline-Electric Servo Motor

- Do not connect the external terminals SON-COM and EMG-COM for the time being.
- Resume the as-manufactured values and set Pr. 00-02 = 10

  Parameter reset

Pr. 00-02	
	10: Parameter reset

- Please check if the Run command comes from the as-manufactured value (operation through external terminals)

  When KPVJ-LE01/KPV-CE01 is used, set Pr. 01-01=0

  Source of Run Command

Pr. 01-01	
	0: Operated by digital operator
	1: Operated by external terminals, Stop on keypad is disabled
	2: Communication port RS-485 is activated and Stop on keypad is disabled

  When VFD-Explorer is used, set Pr. 01-01=2

  Source of Run Command

Pr. 01-01	
	0: Operated by digital operator
	1: Operated by external terminals, Stop on keypad is disabled
	2: Communication port RS-485 is activated and Stop on keypad is disabled

- Set Pr. 01-35 of the gasoline-electric servo motor

HES063H23A, HES080G23A, HES080H23A, HES100G23A,HES100H23A	Pr. 01-35 = 16
HES063G43A, HES063H43A, HES080G43A, HES080H43A, HES100G43A,HES100H43A	Pr. 01-35 = 17
HES125G23A, HES125H23A, HES160G23A,HES160H23A	Pr. 01-35 = 18
HES125G43A, HES125H43A, HES160G43A,HES160H43A	Pr. 01-35 = 19
HES200G43A, HES200H43A	Pr. 01-35 = 21

- Disregard the error message EF1 that will appear at this point.
- After power outage, connect the heating switch of the gasoline-electric servo motor to the external terminal EMG-COM and restart the power supply.

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Step 3.Check Pressure Feedback Signal

- Firs, set input voltage Pr. 00-04 = 11 PO

  Selection of Display Mode

Pr. 00-04	11: Display the signal of PO analog input terminal, with 0~10V corresponding to 0~100%.

- Set Pr. 00-08=corresponding pressure settings of the 10V pressure sensor

  Maximum value of pressure feedback

Pr. 00-08	0~250Bar

- Set Rotation speed command to 10rpm and press【RUN】. Check the pressure value is >0 on the pressure gauge.

  When the pressure value is ≦0,

  ☑ Gradually increase the rotation speed.

  ☑ Check that each directional valve is closed.

  When the pressure value is ＞0

  ☑ Check that the voltage reading displayed on the operation panel is consistent with the pressure reading on the pressure gauge.

  Example: 10V on the pressure sensor corresponds to 250bar. When the pressure gauge reading is 50 bar, the output voltage on the pressure sensor should be approximately 50/250*10=2V. So the voltage displayed on the operation panel will be 20.0(%).

- Meanwhile, observe if there is any oil leak.

Step 4. Check Pressure and Flow Commands

- This action does not need to start the servo oil pump.
- Pr. 00-09 = 1 refers to the pressure control mode

  Pressure Control Mode

Pr. 00-09	0: Speed control 1: Pressure control

- Pr. 00-04 = 12 sets the PI input voltage

  Selection of Display Mode

Pr. 00-04	12: Display the signal value of the PI analog input terminal, with 0~10V corresponding to 0~100%.

- Pr. 00-07 = corresponding pressure value with 10V on the pressure controller command

  Maximum pressure command

Pr. 00-07	0~250Bar

- With the maximum pressure set by the controller, observe the associated value displayed on the operation panel and set it to 00-14.
- With the controller setting at half the maximum pressure, observe the associated value displayed on the operation panel and set it to 00-15.
- With the controller setting at the lowest pressure, observe the associated value displayed

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on the operation panel and set it to 00-16.

Example: 10V on the pressure sensor corresponds to 250bar. If the maximum pressure on the controller is 140bar and corresponds to 10V, the Pr. 00-07=140. Set 140bar through the controller and the voltage reading displayed on the operation panel is approximately 56.0(140/250*100%). Enter this value to Pr. 00-14. Next, set 70bar through the controller and the voltage reading displayed on the operation panel is approximately 28.0 (70/250*100%). Enter this value to Pr. 00-15. Lastly, set 0bar through the controller and the voltage reading displayed on the operation panel is approximately 0.0(0/250*100%). Enter this value to Pr. 00-16.

Example: 10V on the pressure sensor corresponds to 250bar. However, the maximum pressure on the controller is 140bar and corresponds to 7V. As a result, Pr. 00-07= 140/7*10=200. The following steps are the same as described in the previous example. Set 200bar through the controller first, followed by setting 100bar, and 0bar in the last step. Enter the corresponding values to the associated parameters.

- Pr. 00-04 = 25 refers to the QI input voltage

Selection of Display Mode

Pr. 00-04	25: Displays the signal value of the QI analog input terminal, with 0~10V corresponding to 0~100%.

- Set 100% flow rate through the controller, observe the reading displayed on the operation panel and enter it to 00-17
- Set 50% flow rate through the controller, observe the reading displayed on the operation panel and enter it to 00-18
- Set 0% flow rate through the controller, observe the reading displayed on the operation panel and enter it to 00-19

Step 5. Send Run Command via Controller

- Check that Pr. 00-09 is 1 (pressure control mode)

Pressure Control Modes

Parameter00-09 Settings	0: Speed Control 1: Pressure Control

- Pr. 01-01=1

Source of Run Command

Pr. 01-01	0: Operated by digital operator 1: Operated by external terminals, Stop on keypad is disabled 2: Communication port RS-485 is activated and Stop on keypad is disabled

- In case of power outage, connect SON-COM and turn on the power supply.

Step 6.Execute loop vent and verify there is no plastic material in the line and the machine can function without any plastic material.

- In the case of low pressure and low speed (within 30% of rating), the controller utilizes "Manual Run" to operate each oil tank. While the system is in action, check if the oil line is

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leaking and for any noise in the oil pump.

- When the air is vented completely, if there is any pressure fluctuation while the system is in action, please refer to the methods listed in the "Descriptions of Parameters" to adjust the pressure control PI parameter.

Step 7. Injection/Hold up Adjustments

- Conduct material line heating to reach the preset temperature, with the controller in manual control mode.
- Set the Ki value of the three-stage PI to 0 (Pr. 00-21, 00-23, and 00-25）and the three-stage Kp value to be small (≦50.0)
- Execute the injection, with “Preset Target” set at low pressure (＜50Bar) and low flow rate (＜30%)
- Press “Injection” on the controller and the injection will be started or the system will directly enter the hold up action (depending on the location of the oil tank)
- In the hold up state, observe the waferform through the software tool (VFD-Explorer). Increase the speed bandwidth to the maximum value of 40Hz (Pr. 00-10) while causing no vibration to the gasoline-electric servo motor.
- In the hold up state, when the pressure gauge needle or the monitored waferform shows no signs of vibration, the pressure feedback is stabilizing. Now the three sets of Kp values can be increased.
- When the pressure feedback becomes unstable, lower the three sets of Kp values by 20% (Example: lower the preset values of the three sets of Kp values from 100% to 80%), followed by adjusting the three sets of Ki values to eliminate the steady-state error and speed up the system response.
- Upon completion of the above steps, increase the pressure command of “Preset Target”.
- Observe if the pressure feedback becomes stable. Proceed with troubleshooting in case of any anomaly, as described below:

Troubleshooting for Pressure Instability

Unstable pressure over the entire section

1. Set Pr. 00-09 = 0 for speed control
2. With the oil line in the closed state, send the low speed rotation command to make the pressure feedback 40~50% of the pressure command value (Pr. 00-07)
3. Check if the pressure waveform shows any jitters through the monitoring software.
   - Jitter in Pressure Waveform

     The possible cause is interference from ground. If the motor or the three-phase power supply is grounded, disconnect the ground wire. If the motor or the three-phase power supply is not grounded, add the ground wire for interference protection.

     The other possibility is the ground issue of the shielding mesh (as illustrated by

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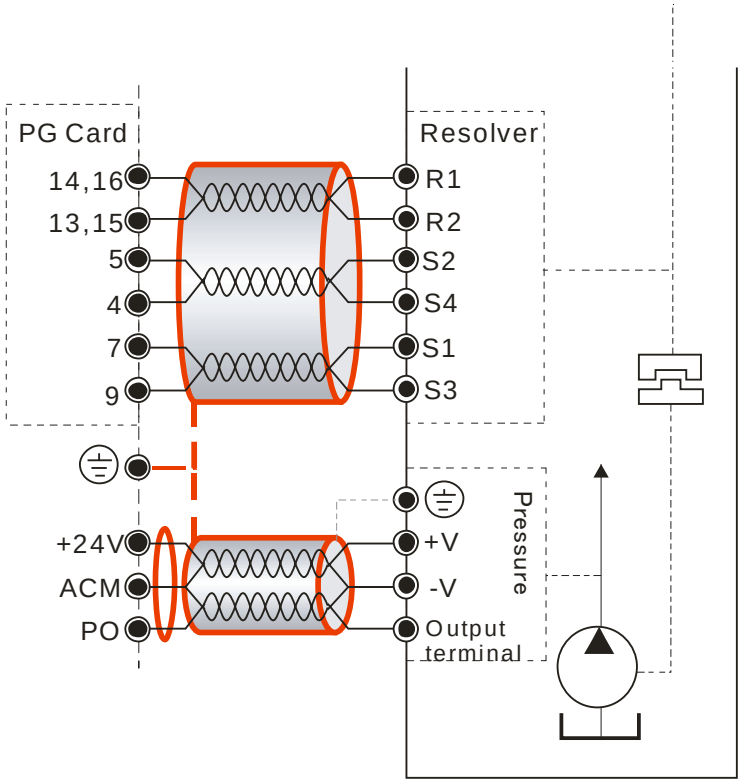
the bold red lines in the figure below). If the shielding mesh is grounded, disconnect the ground wire. If the shielding mesh is not grounded, add the ground wire for interference protection.



4. Please contact the original manufacturer if the anomaly still cannot be resolved after resorting to the methods described above.

Step 8. Adjustment of System Transient Response

- Reduce the pressure ramp up time by increasing Kp1 (Pr. 00-20) and reducing Ki1 (Pr. 00-21) times
- When the pressure is over-adjusted, increase Kp3 (Pr. 00-24) and reduce Ki3 (Pr. 00-25) times

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Configuration Flow of Combined System

Follow the associated descriptions in Chapter 2 to lay out the wiring.

Follow steps 1 and 2 described above to enter the electrical codes for the master/slave machines. Then proceed with the steps below.

Master Machine Configuration

- Set Pr. 03-06=1

  Multi-function Output 2 (MO1)

Pr. 03-06	
	1:Running

- Connect the MO1 output of the master machine to the SON point of the slave machine and connect the MCM of the master machine to the COM of the slave machine.
- Set Pr. 03-13=1

  Selection of Combined Main/Slave Station

Pr. 03-13	0: No function
	1: Master station
	2: Slave station

- Set Pr. 03-14

  Flow rate percentage of slave station in master station

Pr. 03-14	0.0~6553.5%

Slave Machine Configuration

- Set Pr. 01-01=1

  Source of Run Command

Pr. 01-01	0: Operated by digital operator
	1: Operated by external terminals, Stop on keypad is disabled
	2: Communication port RS-485 is activated and Stop on keypad is disabled

- Set Pr. 03-15=1

  Source Configuration of Frequency Command

Pr. 03-15	0: Digital operator
	1: RS485 communication
	2~5: Reserved

- In case of power outage, resume the power supply.

  Set an arbitrary value for the master machine frequency and observe if the slave machine responds with the same frequency.

  Set 10rpm in the master machine and press RUN. Observe if the slave machine is also running. If not, check if there is any issue with the wiring.

  Set Pr. 03-13=2 in Slave machine

  Source Configuration of Frequency Command

  Selection of Combined Master/Slave Machine

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Pr. 03-13	0: No function
	1: Master station
	2: Slave station

Resume power supply to slave machine after power outage

Set slave machine to speed control mode

Pr. 00-09 = 0 Speed control mode

Speed Control Mode

Pr. 00-09	0: Speed control
	1: Pressure control

At this point, the Master machine can be adjusted by the following steps 3-8 described above.

Steps of Configuration Flow for System Combining/Diversion

Follow the associated descriptions in Chapter 2 to lay out the wiring.

In the diversion state, follow steps 1-8 described above to individually adjust the parameters of each driver.

In the combined state, refer to the configuration flow for combined system.

Complete the above steps.

Set the Master machine to run in pressure control mode.

- Pr. 00-09 = 1 Pressure control mode

  Pressure control mode

Pr. 00-09	0: Speed control
	1: Pressure control

Set the Slave machine to run in speed control mode

- Pr. 00-09 = 0 Speed control mode

  Speed control mode

Pr. 00-09	0: Speed control
	1: Pressure control

Set the multi-functional input states of Master/Slave separately

- Pr. 03-00~03-02 = 45 Combined/Diversion signal input

  Multi-functional input

Pr. 03-00~	0: No function
03-02	45: Input of Combined/Diversion signal

- Execute the entire combined/diversion action through the position machine.

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Chapter 4 Parameters

4-1 Summary of Parameter Settings
4-2 Description of Parameter Settings

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4-1 Summary of Parameter Settings

00 System Parameters

↗: The parameter can be set during operation.

Pr.	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
00-00	Identity Code of the Hybrid Servo Controller	12: 230V, 7.5HP 13: 460 V, 7.5HP 14: 230V, 10HP 15: 460V, 10HP 16: 230V, 15HP 17: 460V, 15HP 18: 230V, 20HP 19: 460V, 20HP 20: 230V, 25HP 21: 460V, 25HP 22: 230V, 30HP 23: 460V, 30HP 24: 230V, 40HP 25: 460V, 40HP 26: 230V, 50HP 27: 460V, 50HP 29: 460V, 60HP 31: 460V, 75HP 33: 460V, 100HP	Read Only	○	○	○
00-01	Rated Current Display of the Hybrid Servo Controller	Read-only	#	○	○	○
00-02	Parameter reset	0: No function 5: Resets to Wh display value in stop status. 10: All parameters are reset to factory settings (60Hz).	0	○	○	○
00-03	Software Version	Read Only	Read Only	○	○	○

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	Pr.	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
✓	00-04	Content of Multi-function Display	0: Displays the output current (A) from Hybrid Servo Controller to motor. 1: Reserved 2: Displays the actual output frequency (H) of the Hybrid Servo Controller. 3: Display the DC bus voltage (U) of the Hybrid Servo Controller. 4: Displays the U, V and W output voltage (E) of the Hybrid Servo Controller. 5: Displays the output power factor and angle (n) of the Hybrid Servo Controller. 6: Displays the output power kW (P) of the Hybrid Servo Controller. 7: Displays the actual speed (rpm, r) of the Hybrid Servo Controller. 8: Displays the estimated output torque N-m (%) of the Hybrid Servo Controller. 9: Displays the PG feedback (G). 10: Reserved 11: Displays the signal value % of the PO analog input terminal. 12: Displays the signal value % of the PI analog input terminal. 13: Displays the signal value % of the AUI analog input terminal. 14: Displays the heat-sink temperature °C (t.) of the Hybrid Servo Controller. 15: The temperature °C of the power module IGBT. 16: The ON/OFF status of the digital input. 17: The ON/OFF status of the digital output. 18: Reserved 19: The status of the corresponding CPU pins of digital input. 20: The status of the corresponding CPU pins of digital output. 21~24: Reserved. 25: Displays the signal value % of the QI analog input terminal. 26: Displays the actual pressure value (Bar). 27: Displays Wh. 28: Displays motor temperature (currently supports KTY84 only)	0	○	○	○
✓	00-05	Analog Output Selection	0: Output frequency (Hz)	0	○	○	○
			1: Frequency command (Hz)		○	○	○
			2: Motor speed (Hz)		○	○	○
			3: Output current (A)			○	○
			4: Output voltage		○	○	○
			5: DC Bus voltage		○	○	○
			6: Power factor		○	○	○
			7: Power				
			8: Output torque				
			9: PO				
			10: PI				
			11: AUI		○	○	○
			12~20: Reserved		○	○	○
	00-06	User-defined: Display actual motor speed in rpm	0~39999 rpm	0	○	○	○
✓	00-07	Maximum Value of Pressure Command	0~250 Bar	250	○	○	○
✓	00-08	Maximum Value of Pressure Feedback	0~400 Bar	250	○	○	○
	00-09	Pressure Control Mode	0: Speed Control 1: Pressure Control	0	○	○	○
	00-10	Speed Bandwidth	0~40Hz	20		○	○
✓	00-11	Pressure Feedback Filter Time PO	0.000~1.000 sec	0.000	○	○	○

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	Pr.	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
✓	00-12	Pressure Command Filter Time PI	0.000~1.000 sec	0.000	○	○	○
✓	00-13	Flow Command Filter Time QI	0.000~1.000 sec	0.000	○	○	○
✓	00-14	Pressure Command Percentage (Max)	0.0~100.0%	100.0	○	○	○
✓	00-15	Pressure Command Percentage (Mid)	0.0~100.0%	50.0	○	○	○
✓	00-16	Pressure Command Percentage(Min)	0.0~100.0%	0.0	○	○	○
✓	00-17	Flow Command Percentage (Max)	0.0~100.0%	100.0	○	○	○
✓	00-18	Flow Command Percentage (Mid)	0.0~100.0%	50.0	○	○	○
✓	00-19	Flow Command Percentage (Min)	0.0~100.0%	0.0	○	○	○
✓	00-20	Proportional Gain 1 (P)	0.0~1000.0	50.0	○	○	○
✓	00-21	Integral Time 1 (I)	0.00~500.00 sec	2.00	○	○	○
✓	00-22	Proportional Gain 2 (P)	0.0~1000.0	50.0	○	○	○
✓	00-23	Integral Time 2 (I)	0.00~500.00 sec	2.00	○	○	○
✓	00-24	Proportional Gain 3 (P)	0.0~1000.0	50.0	○	○	○
✓	00-25	Integral Time 3 (I)	0.00~500.00 sec	2.00	○	○	○
✓	00-26	Pressure Stabilization Zone	0~100%	25	○	○	○
✓	00-27	Bottom Pressure	0.0~100.0%	1.0	○	○	○
✓	00-28	Pressure Relief Speed	0~100%	25	○	○	○
✓	00-29	Pressure Command Rising Slope	0~1000ms	0	○	○	○
✓	00-30	Pressure Command Descending Slope	0~1000ms	100	○	○	○
✓	00-31	Flow Command Rising Slope	0~1000 ms	80	○	○	○
✓	00-32	Flow Command Descending Slope	0~1000 ms	80	○	○	○
✓	00-33	Value Open Delay Time	0~200 ms	0	○	○	○
✓	00-34	High/Low Flow Reference Point Switch	0.00~100.00 %	50.00	○	○	○
✓	00-35	Over Pressure Detection Level	0~250 Bar	230	○	○	○
✓	00-36	Pressure Feedback Fault Detection	0: No function 1: Enable (for pressure feedback output signal at 1-5V only)	0	○	○	○
✓	00-37	Derivative Gain	0.0~100.0 %	0.0	○	○	○

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01 Motor Parameters

↗: The parameter can be set during operation.

	Pr.	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
	01-00	Control Mode	0: V/f Control 1: Reserved 2: Reserved 3: FOC Vector Control + Encoder (FOCPG) 4: Reserved 5: FOC PM control (FOCPM) 6: Reserved	5	○	○	○
↗	01-01	Source of the Operation Command	0: Digital keypad 1: External terminals. Keypad STOP disabled. 2: RS-485 serial communication. Keypad STOP disabled.	1	○	○	○
	01-02	Maximum Motor Operation Frequency	50.00~600.00Hz	60.00/ 50.00	○	○	○
	01-03	Nominal Motor Frequency	0.00~600.00Hz	60.00/ 50.00	○	○	○
	01-04	Nominal Motor Voltage	230V models: 0.1V~255.0V 460V models: 0.1V~510.0V	220.0 440.0	○	○	
↗	01-05	Acceleration Time	0.00~600.00 sec	0.00	○	○	○
↗	01-06	Deceleration Time	0.00~600.00 sec	0.00	○	○	○
	01-07	Motor Auto Tuning	0: No function	0	○	○	
			1: Rolling test for induction motor(IM) (Rs, Rr, Lm, Lx, no-load current)		○	○	
			2: Static test for induction motor(IM)		○	○	
			3: Reserved		○	○	
			4: Auto measure the angle between magnetic pole and PG origin				○
			5: Rolling test for PM motor				○
	01-08	Full-load Current of Motor (IM)	40~120% of driver nominal current.	#.##		○	
↗	01-09	Rated power of Motor (IM)	0~655.35kW	#.##		○	
↗	01-10	Rated speed of Motor (rpm) (IM)	0~65535 1710(60Hz 4-phase)；1410(50Hz 4-phase)	1710		○	
	01-11	Number of Motor Poles (IM)	2~20	4		○	
	01-12	No-load Current of Motor (IM)	0~Pr. 01-08 Factory setting	#.##		○	
	01-13	Rs of Motor (IM)	0~65.535Ω	#.###		○	
	01-14	Rr of Motor (IM)	0~65.535Ω	#.###		○	
	01-15	Lm of Motor (IM)	0~6553.5mH	#.#		○	
	01-16	Lx of Motor (IM)	0~6553.5mH	#.#		○	
	01-17	Full-load current of Permanent Magnet Motor	0.00~655.35 Amps	0.00			○
	01-18	Rated Power of Permanent Magnet Motor	0.00~655.35kW	0.00			○
	01-19	Rated speed of Permanent Magnet Motor	0~65535	0			○
	01-20	Number of Motor Poles (PM)	2~20	6			○
	01-21	Permanent Motor Rotor Inertia	0.0~6553.5 *10-4 kg.m2	0.0			○
	01-22	Rs of Motor (PM)	0.000~65.535Ω	0.000			○
	01-23	Ld of Motor (PM)	0.00~655.35mH	0.00			○
	01-24	Lq of Motor (PM)	0.00~655.35mH	0.00			○
	01-25	Ke parameter of PM Motor	0~65535 V/krpm	0			○
	01-26	Encoder Type	0: ABZ 1: ABZ+HALL (for Delta motors only) 2: ABZ+HALL 3: Resolver	3			○
	01-27	PG Offset angle of PM Motor	0.0~360.0°	0.0			○
	01-28	Resolver Poles	1~5	1			○
	01-29	Encoder Pulse	1~20000	1024		○	○

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	Pr.	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
	01-30	Encoder Input Type Setup	0: Disable 1: Phase A leads in a forward run command and phase B leads in a reverse run command 2: Phase B leads in a forward run command and phase A leads in a reverse run command 3: Phase A is a pulse input and phase B is a direction input. (low input=reverse direction, high input=forward direction) 4: Phase A is a pulse input and phase B is a direction input. (low input=forward direction, high input=reverse direction) 5: Single-phase input	1		○	○
	01-31	System Control	0: No function 1: Auto tuning for ASR 2: Inertia estimate	1		○	○
✓	01-32	Per Unit of System Inertia	1~65535 (256 = 1 per unit)	400		○	○
	01-33	Carrier Frequency	5KHz; 10KHz	5	○	○	○
✓	01-34	Reserved					
	01-35	Hydraulic Servo Motor ID	0: No function 16: Delta Hydraulic Servo Motor Model #ECMA-ER181BP3 (11kW220V) 17 :Delta Hydraulic Servo Motor Model #ECMA-KR181BP3 (11kW380V) 18: Delta Hydraulic Servo Motor Model #ECMA-ER221FPS (15kW220V) 19: Delta Hydraulic Servo Motor Model #ECMA-KR221FPS (15kW380V) 21: Delta Hydraulic Servo Motor Model #ECMA-KR222APS (20kW380V)	0	○	○	○
	01-36	Rotation Direction Change	0: When the driver runs forward, the motor rotates counterclockwise. When the driver runs backward, the motor rotates clockwise. 1: When the driver runs forward, the motor rotates clockwise. When the driver runs backward, the motor rotates counterclockwise.	0	○	○	○

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02 Protection Parameters

↗: The parameter can be set during operation.

	Pr.	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
↗	02-00	Software Brake Level	230V Series: 350.0~450.0Vdc 460V Series: 700.0~900.0Vdc	380.0 760.0	○	○	○
	02-01	Present Fault Record	0: No fault record	0	○	○	○
	02-02	Second Most Recent Fault Record	1:Over-current during acceleration (ocA)	0	○	○	○
	02-03	Third Most Recent Fault Record	2:Over-current during deceleration (ocd)	0	○	○	○
	02-04	Fourth Most Recent Fault Record	3:Over-current during constant speed (ocn)	0	○	○	○
	02-05	Fifth Most Recent Fault Record	4:Ground fault (GFF)	0	○	○	○
	02-06	Sixth Most Recent Fault Record	5: IGBT short-circuit (occ)	0	○	○	○
			6: Over-current at stop (ocS)		○	○	○
			7: Over-voltage during acceleration (ovA)		○	○	○
			8: Over-voltage during deceleration (ovd)		○	○	○
			9: Over-voltage during constant speed (ovn)		○	○	○
			10: Over-voltage at stop (ovS)		○	○	○
			11: Low-voltage during acceleration (LvA)		○	○	○
			12: Low-voltage during deceleration (Lvd)		○	○	○
			13: Low-voltage during constant speed (Lvn)		○	○	○
			14: Stop mid-low voltage (LvS)		○	○	○
			15: Phase failure protection (PHL)		○	○	○
			16: IGBT over-heat (oH1)		○	○	○
			17: Heat sink over-heat (oH2)(for 40HP above)		○	○	○
			18: tH1o (TH1 open: IGBT over-heat protection error)		○	○	○
			19: tH2o (TH2 open: capacitance over-heat protection error)		○	○	○
			20: Fan error signal output		○	○	○
			21: over-load (oL) (150% 1Min)		○	○	○
			22: Motor over-load (EoL1)		○	○	○
			23: Reserved				
			24: Motor PTC overheat (oH3)		○	○	○
			25: Reserved				
			26: over-torque 1 (ot1)		○	○	○
			27: over-torque 2 (ot2)		○	○	○
			28: Reserved		○	○	○
			29: Reserved		○	○	○
			30: Memory write-in error (cF1)		○	○	○
			31: Memory read-out error (cF2)		○	○	○
			32: Isum current detection error (cd0)		○	○	○
			33: U-phase current detection error (cd1)		○	○	○
			34: V-phase current detection error (cd2)		○	○	○
			35: W-phase current detection error (cd3)		○	○	○
			36: Clamp current detection error (Hd0)		○	○	○
			37: Over-current detection error (Hd1)		○	○	○
			38: Over-voltage detection error (Hd2)		○	○	○
			39: Ground current detection error (Hd3)		○	○	○
			40: Auto tuning error (AuE)			○	○
			41: Reserved		○	○	○
			42: PG feedback error (PGF1)			○	○
			43: PG feedback loss (PGF2)			○	○
			44: PG feedback stall (PGF3)			○	○
			45: PG slip error (PGF4)			○	○
			46: Reserved		○	○	○
			47: Reserved		○	○	○
			48: Reserved				

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	Pr.	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
			49: External fault input (EF)		○	○	○
			50: Emergency stop (EF1)		○	○	○
			51: Reserved				
			52: Password error (PcodE)		○	○	○
			53: Reserved.		○	○	○
			54: Communication error (cE1)		○	○	○
			55: Communication error (cE2)		○	○	○
			56: Communication error (cE3)		○	○	○
			57: Communication error (cE4)		○	○	○
			58: Communication Time-out (cE10)		○	○	○
			59: PU time-out (cP10)		○	○	○
			60: Brake chopper error (bF)		○	○	○
			61~63: Reserved		○	○	○
			64: Safety loop error (Sry)		○	○	○
			65: PGF5 hardware error				○
			66: Over pressure (ovP)		○	○	○
			67: Pressure feed back fault (PfbF)		○	○	○
✓	02-07	Low Voltage Level	160.0~220.0Vdc 320.0~440.0Vdc	180.0 360.0	○	○	○
✓	02-08	PTC Detection Selection	0: Warn and keep operation 1: Warn and ramp to stop 2: Warn and coast to stop	0	○	○	○
✓	02-09	PTC Level	0.0~150.0% 0.0~150.0℃	50.0	○	○	○
✓	02-10	PTC Detection Filter Time	0.00~10.00 sec	0.20	○	○	○
✓	02-11	PTC Mode	0: Unspecified 1: KTY84	0	○	○	○
✓	02-12	Motor Fan Activation Reference Point	0.0~100.0% 0.0~150.0℃	50.0	○	○	○
✓	02-13	Electronic Thermal Relay Selection 1	0: Inverter motor 1: Standard motor 2: Disable	2	○	○	○
✓	02-14	Electronic Thermal Characteristic for Motor 1	30.0~600.0 sec	60.0	○	○	○
	02-15	Output Frequency at Malfunction	0.00~655.35 Hz	Read Only	◯	◯	◯
	02-16	Output Voltage at Malfunction	0.0~6553.5 V	Read Only	◯	◯	◯
	02-17	DC Voltage at Malfunction	0.0~6553.5 V	Read Only	◯	◯	◯
	02-18	Output Current at Malfunction	0.00~655.35 Amp	Read Only	◯	◯	◯
	02-19	IGBT Temperature at Malfunction	0.0~6553.5 ℃	Read Only	◯	◯	◯

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03 Digital/Analog I/O Parameters

✓: The parameter can be set during operation.

	Pr.	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
	03-00	Multi-functional Input Command 3 (MI3)	0: No function 44: Injection signal input 45: Combination/Diversion signal input	0	○	○	○
	03-01	Multi-functional Input Command 4 (MI4)		0	○	○	○
	03-02	Multi-functional Input Command 5 (MI5)		0	○	○	○
✓	03-03	Digital Input Response Time	0.001~ 30.000 sec	0.005	○	○	○
✓	03-04	Digital Input Operation Direction	0~65535	0	○	○	
✓	03-05	Multi-functional Output 1 (Relay 1)	0: No function 1: Operation Indication 9: Hybrid Servo Controller is ready 11: Malfunction indication 44: Ram pump flow switch signal 45: Motor fan control signal	11	○	○	○
✓	03-06	Multi-functional Output 2 (MO1)		0	○	○	○
✓	03-07	Multi-functional Output 3 (MO2)		0	○	○	○
✓	03-08	Multi-functional Output Direction	0~65535	0		○	
✓	03-09	Low-pass Filter Time of Keypad Display	0.001~65.535 sec	0.010	○	○	○
	03-10	Pressure Feedback Maximum Output Voltage	5~10 V	10	○	○	○
	03-11	Pressure Feedback Minimum Output Voltage	0~1 V	0	○	○	○
✓	03-12	Reserved					
	03-13	Combination Sever/Slave Selection	0: No function 1: Server 2: Slave	0	○	○	○
	03-14	Slave to Server Flow Rate	0.0~65535.5 %	100.0	○	○	○
✓	03-15	Source of the Master Frequency Command	0: Digital keypad 1: RS-485 serial communication 2~5: Reserved	0	○	○	○
✓	03-16	Slave Motor Reverse Rotation Pressure Relief Torque Limit	0~500%	20	○	○	○
	03-17	Reserved					
✓	03-18	Transmission Fault Treatment	0: Warn and keep operation 1: Warn and ramp to stop 2: Warn and coast to stop 3: No action and no display	3	○	○	○
✓	03-19	Time Out Detection	0.0~100.0 sec	0.0	○	○	○
✓	03-20	Start-up Display Selection	0: Display the frequency command value (LED F) 1: Display the actual output frequency (LED H) 2: Multi-function display, see Pr.00-04 3: Display the output current (A)	0	○	○	○

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4-2 Description of Parameter Settings

00 System Parameters

↗: The parameter can be set during operation.

00-00 Identity Code of the Hybrid Servo Controller

Control Mode VF FOCPG FOCPM Factory setting: ##

Settings Read Only

00-01 Hybrid Servo Controller

Control Mode VF FOCPG FOCPM Factory setting: ##

Settings Read Only

🕮 Pr.00-00 System parameters determine the Hybrid Servo Controller capacity. They are set in the system before shipping. Also, the current of Pr. 00-01 can be retrieved to check the nominal current of respective models. Pr. 00-00 corresponds to the current display in Pr. 00-01.

230V Series								
kW	5.5	7.5	11	15	18.5	22	30	37
HP	7.5	10	15	20	25	30	40	50
Pr.00-00	12	14	16	18	20	22	24	26

460V Series											
kW	5.5	7.5	11	15	18.5	22	30	37	45	55	75
HP	7.5	10	15	20	25	30	40	50	60	75	100
Pr.00-00	13	15	17	19	21	23	25	27	29	31	33

00-02 Parameter Reset

Control Mode VF FOCPG FOCPM Factory setting: 0

Settings 0: No function

5: Resets to Wh display value in stop status.

10: All parameters are reset to factory settings (60Hz).

🕮 Set the parameter to “10” to reset the parameter to the Factory setting.

00-03 Software Version

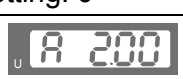
Control Mode VF FOCPG FOCPM Factory setting: #.##

Settings Read Only

↗ 00-04 Content Multi-function Display

Control Mode VF FOCPG FOCPM Factory setting: 0

Settings 0: Displays the output current (A) from Hybrid Servo Controller to motor.



1: Reserved

2: Displays the actual output frequency (H) of the Hybrid Servo Controller.

3: Display the DC bus voltage (U) of the Hybrid Servo Controller.

4: Displays the U, V and W output voltage (E) of the Hybrid Servo Controller.

5: Displays the output power factor and angle (n) of the Hybrid Servo Controller.

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6: Displays the output power kW (P) of the Hybrid Servo Controller.

7: Displays the motor speed (rpm, r) estimated by the Hybrid Servo Controller or fed back from the encoder. (r00: Positive Forward Speed; - 00: Minus Speed)

8: Displays the estimated positive and negative output torque N-m of the Hybrid Servo Controller (t 0.0: Positive Torque; - 0.0: Negative Torque) (%).

9: Displays the PG feedback (G).

10: Reserved.

11: Displays the signal value of the PO analog input terminal: 0-10V correspond to 0-100%.

12: Displays the signal value of the PI analog input terminal: 0-10V correspond to 0-100%.

13: Displays the signal value of the AUI analog input terminal: -10-10V correspond to 0-100%.

14: Displays the heat-sink temperature °C (t.) of the Hybrid Servo Controller.

15: The temperature °C of the power module IGBT.

16: The ON/OFF status of the digital input.

17: The ON/OFF status of the digital output.

18: Reserved

19: The status of the corresponding CPU pins of digital input.

20: The status of the corresponding CPU pins of digital output.

21~24: Reserved.

25: Displays the signal value of the QI analog input terminal: 0-10V correspond to 0-100%.

26: Displays the actual pressure value (Bar).

27: Displays Wh.

28: Displays motor temperature (currently supports KTY84 only)

🕮 This parameter defines the display contents in the U page of digital operator KPV-CE01.

00-05 Analog Output Selection

Control Mode VF FOCPG FOCPM Factory setting: 0

Settings 0~20

Settings	Functions	Descriptions
0	Output frequency (Hz)	Maximum frequency is 100%.
1	Frequency command (Hz)	Maximum frequency is 100%.
2	Motor speed (Hz)	600Hz is 100%.
3	Output current (A)	2.5 times of the controller nominal current is 100%.
4	Output voltage	2 times of the motor nominal voltage is 100%.
5	DC Bus voltage	450V (900V) = 100%
6	Power factor	-1.000-1.000 = 100%
7	Power	Controller nominal power = 100%
8	Output torque	Nominal torque = 100%
9	PO	(0-10V=0-100%)
10	PI	(0-10V=0-100%)
11	AUI	(-10-10V=0-100%)

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12-20	Reserved

00-06 User-defined: Display actual motor speed in rpm

Control Mode VF FOCPG FOCPM Factory setting: 0

Settings 0~39999rpm

🕮 Sets the hydraulic motor speed at 100% flow.

↗ 00-07 Maximum Value of Pressure Command

Control Mode VF FOCPG FOCPM Factory setting: 250

Settings 0~250Bar

🕮 Sets the corresponding parameter value, 0-this value, of the controller pressure command 0-10V.

↗ 00-08 Maximum Value of Pressure Feedback

Control Mode VF FOCPG FOCPM Factory setting: 250

Settings 0~400Bar

🕮 Sets the corresponding parameter value, 0-this value, of the pressure detection value 0-10V.

00-09 Pressure Control Mode

Control Mode VF FOCPG FOCPM Factory setting: 0

Settings 0: Speed Control

1: Pressure Control

🕮 This parameter allows users to select the control mode of the Hybrid Servo Controller. It is strongly advised that users should select the Speed Control Mode when using the controller for the first time. This way, users can verify if there are errors in the hydraulic servo motor, oil pump, pressure sensor, and system before switching to Pressure Control Mode to enter the full process control for the mold injection machine.

00-10 Speed Bandwidth

Control Mode FOCPG FOCPM Factory setting: 20

Settings 0~40Hz

🕮 Sets the speed response; the greater the value, the faster the response.

↗ 00-11 Pressure Feedback Filter Time PO
↗ 00-12 Pressure Feedback Filter Time PI
↗ 00-13 Pressure Feedback Filter Time QI

Control Mode VF FOCPG FOCPM Factory setting: 0.000

Settings 0.000~1.000 sec

🕮 The analog signals input from the control terminals PO, PI, and QI usually contain noise. As noise will affect control stability, input these signals to the filter to filter noise contained in the analog input signal.

🕮 When the filter time is too long, the control will be more stable, but the control response will be slower. When the filter time is too short, the control response time will be faster, but the control will be less stable. If users do not know the optimal filter time, adjust the filter time according to the instability or response delay of control.

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00-14 Pressure Command Percentage (MAX)
00-15 Pressure Command Percentage (Mid)
00-16 Pressure Command Percentage (Min)

Control Mode VF FOCPG FOCPM Factory setting: 100.0

Settings 0.0~100.0%

🕮 Set the Pr.00-09 to "1" before setting these parameters.

Pr.00-04=12 PI input voltage.

Set controller pressure to (MAX) and observe the controller pressure on the multi-function display. Then, input the value in Pr.00-14.

Set controller pressure to (Mid) and observe the controller pressure on the multi-function display. Then, input the value in Pr.00-15.

Set controller pressure to (Min) and observe the controller pressure on the multi-function display. Then, input the value in Pr.00-16.

Example:

Pressure sensor 10V corresponds to 250 bar. If the maximum controller pressure is 140 bar, this corresponds to 10V, Pr.00-07=140. Set controller pressure to 140 bar; the voltage displayed on the multi-function display is about 56.0 (140/250*100%). Input this value to Pr.00-14. Next, set controller pressure to 70 bar, the voltage displayed on the multi-function display is about 28.0 (70/250*100%). Input this value to Pr.00-15. Lastly, set controller pressure to 0 bar, the voltage displayed on the multi-function display is about 0.0(0/250*100%). Input this value to Pr.00-16.

00-17 Flow Command Percentage (Max)
00-18 Flow Command Percentage (Mid)
00-19 Flow Command Percentage (Min)

Control Mode VF FOCPG FOCPM Factory setting: 100.0

Settings 0.0~100.0%

🕮 Set the Pr.00-09 to "1" before setting these parameters.

🕮 Pr.00-04 =25 QI input voltage.

Set controller flow to 100%, observe the flow displayed on the multi-function display, input this value to Pr.00-17.

Set controller flow to 50%, observe the flow displayed on the multi-function display, input this value to Pr.00-18.

Set controller flow to 0%, observe the flow displayed on the multi-function display, input this value to Pr.00-19.

00-20 Proportional Gain 1 (P)
00-22 Proportional Gain 2 (P)
00-24 Proportional Gain 3 (P)

Control Mode VF FOCPG FOCPM Factory setting: 50.0

Settings 0.0~1000.0

00-21 Integral Time 1 (I)
00-23 Integral Time 2 (I)

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00-25 Integral Time 3 (I)

Control Mode VF FOCPG FOCPM Factory setting: 2.00

Settings 0.00~500.00 sec

00-37 Derivative Gain

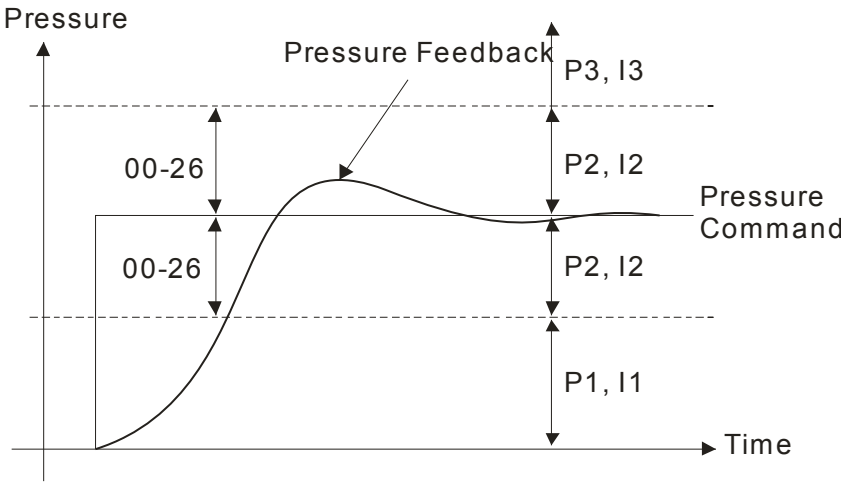
Control Mode VF FOCPG FOCPM Factory setting: 0.0

Settings 0.0~100.0 %

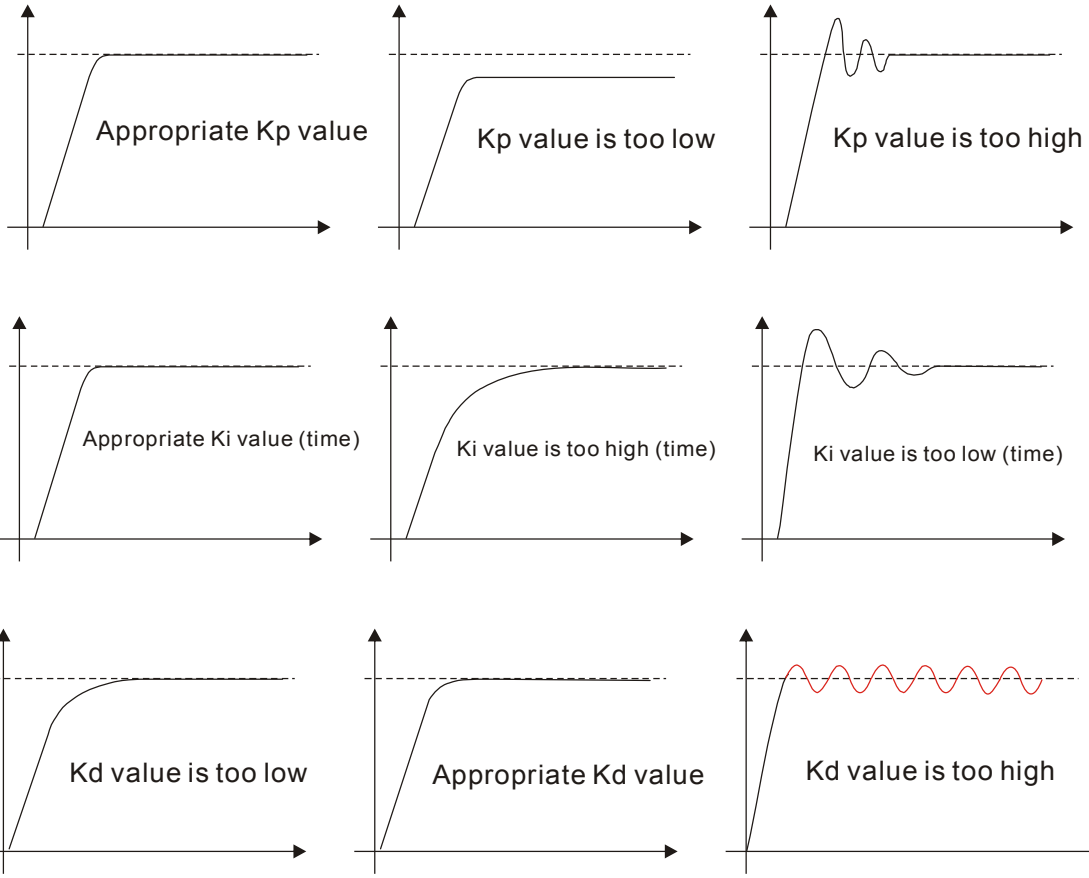
00-26 Pressure Stabilization Zone

Control Mode VF FOCPG FOCPM Factory setting: 25

Settings 0~100%



First, adjust the Kp value to the most appropriate value. Then, adjust time Ki value (time). Adjust the Kd value when pressure is over-adjusted.


Appropriate Kp value
Kp value is too low
Kp value is too high
Appropriate Ki value (time)
Ki value is too high (time)
Ki value is too low (time)
Kd value is too low
Appropriate Kd value
Kd value is too high

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00-27 Bottom Pressure

Control Mode VF FOCPG FOCPM Factory setting: 1.0

Settings 0.0~100.0%

- Sets the lowest pressure; 100% corresponds to Pr.00-08.
- In general, bottom pressure at a certain degree must be reserved to ensure that there is oil inside the oil pipelines. This way, the oil cylinder action will not be delayed when a pressure/flow command starts.

00-28 Pressure Relief Speed

Control Mode VF FOCPG FOCPM Factory setting: 25

Settings 0~100%

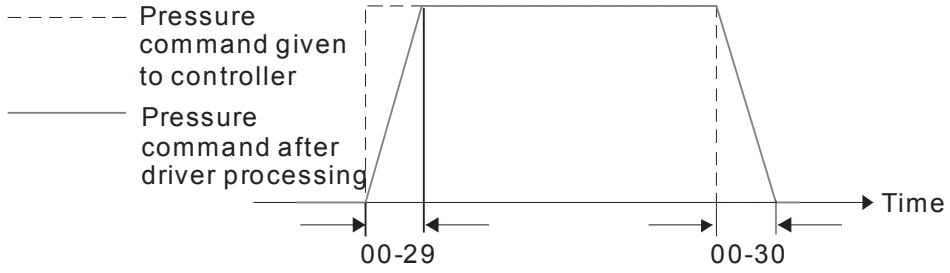
- Sets the highest speed of pressure relief; 100% corresponds to Pr.01-02.

00-29 Pressure Command Rising Slope
00-30 Pressure Command Descending Slope

Control Mode VF FOCPG FOCPM Factory setting: 100

Settings 0~1000ms

- Applies slope processing to pressure commands to relieve machine vibration.
- The lead-time to increase pressure from 0 to maximum pressure (Pr.00-08).

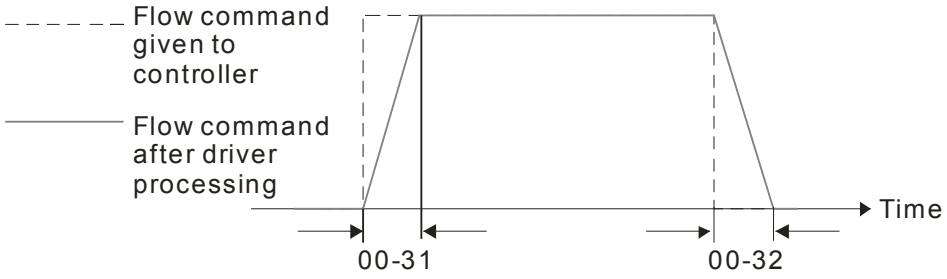


00-31 Flow Command Rising Slope
00-32 Flow Command Descending Slope

Control Mode VF FOCPG FOCPM Factory setting: 80

Settings 0~1000ms

- Applies slope processing to flow commands to relieve machine vibration.
- The lead-time to increase flow from 0 to maximum flow (Pr.01-02).



00-33 Valve Open Delay Time

Control Mode VF FOCPG FOCPM Factory setting: 0

Settings 0~200ms

- When the pressure and flow commands rise at the same time from system standby status, flow output

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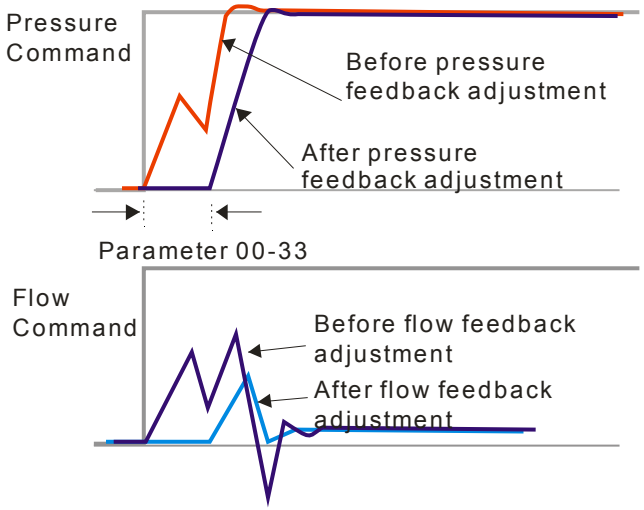
begins. As the valve opening action responds rather slowly, pressure surges instantaneously and returns to normal until the valve opens completely. In order to prevent this phenomenon, users can set the value open delay time to delay the flow output.



00-34 High/Low Flow Reference Point Switch

Control Mode VF FOCPG FOCPM Factory setting: 50.00

Settings 0.00~100.00 %

When pressure feedback reaches the reference point in Pr.00-34 of the Pressure Command*, if the value in Pr.03-05 to Pr.03-07 of the Multi-function Output is “44: Ram Pump High/Low Flow Switch Signal”, the ram pump slope switch singal will be output.

00-35 Over pressure Detection Level

Control Mode VF FOCPG FOCPM Factory setting: 230

Settings 0~250 Bar

When pressure feedback exceeds the value set in this parameter, the “ovP Over Pressure” error message will be generated.

00-36 Pressure Feedback Fault Detection

Control Mode VF FOCPG FOCPM Factory setting: 0

Settings 0 : No function

1: Enable (for pressure feedback output signal at 1-5V only)

When the parameter is set to “1”, if the pressure feedback output signal is lower than 1V, the “Pfbf Pressure Feedback Fault” error message will be generated.

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01 Motor Parameters

↗: The parameter can be set during operation.

01-00 Control Mode

Control Mode VF FOCPG FOCPM Factory setting: 5

Settings 0: V/F Control
1: Reserved
2: Reserved
3: FOC Vector Control + Encoder (FOCPG)
4: Reserved
5: FOC PM control (FOCPM)
6: Reserved

🕮 This parameter determines the control mode of the Hybrid Servo Controller.
0: V/F-Users can design the V/F ratio according to their needs with an induction motor.
3: FOC Vector Control + Encoder (FOCPG) with an induction motor.
5: FOCPM Vector Control + Encoder (FOCPG) with a permanent motor.

↗ 01-01 Source of the Operation Command

Control Mode VF FOCPG FOCPM Factory setting: 1

Settings 0: Digital keypad
1: External terminals. Keypad STOP disabled.
2: RS-485 serial communication. Keypad STOP disabled.

🕮 Press the PU key on the panel until the “PU” indicator illuminates to activate the RUN, JOG and STOP keys.

01-02 Maximum Motor Operation Frequency

Control Mode VF FOCPG FOCPM Factory setting: 60.00/50.00

Settings 50.00~600.00Hz

🕮 Sets the maximum operation frequency range of the motor. This setting should correspond to the system maximum flow.

01-03 Nominal Motor Frequency

Control Mode VF FOCPG FOCPM Factory setting: 60.00/50.00

Settings 0.00~600.00Hz

🕮 In general, this value is set according to the specifications on the motor nameplate; i.e. the nominal voltage frequency for motor operation. If the motor voltage frequency is 60Hz, set the value to 60Hz. If the motor voltage frequency is 50Hz, set the value to 50Hz.

01-04 Nominal Motor Voltage

Control Mode VF FOCPG Factory setting: 220.0/440.0

Settings 230V Series: 0.1~255.0V
460V Series: 0.1~510.0V

🕮 In general, this value is set according to the specifications on the motor nameplate; i.e. the

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nominal voltage for motor operation. If the motor voltage is 220V, set the value to 220.0V. If the motor voltage frequency is 200V, set the value to 200.0V.

01-05 Acceleration Time

Control Mode VF FOCPG FOCPM Factory setting: 0.00

Settings 0.00~600.00 seconds

01-06 Deceleration Time

Control Mode VF FOCPG FOCPM Factory setting: 0.00

Settings 0.00~600.00 seconds

🕮 The acceleration time determines the lead-time for the driver to accelerate from 0.0Hz to the [Maximum Motor Frequency] (Pr.01-00). The deceleration time determines the lead-time for the driver to deccelerate from the [Maximum Motor Frequency] (Pr.01-00) to 0.0Hz.

01-07 Motor Auto Tuning

Factory setting: 0

		Control Mode VF	FOCPG	FOCPM
Settings	0: No function	○	○	
	1: Rolling test for induction motor(IM) (Rs, Rr, Lm, Lx, no-load current)	○	○	
	2: Static test for induction motor(IM)	○	○	
	3: Reserved			
	4: Auto measure the angle between magnetic pole and PG origin			○
	5: Rolling test for PM motor			○

🕮 When the parameter setting is 1 and 2, run [Induction Motor] parameter auto detection. Press the [Run] key to immediately run auto detection. Detected values will be input in Pr.01-13 to Pr.01-16 unload current, Rs, Rr, Lm, Lx).

Induction Motor Parameter AUTO-Tuning Procedure: (Dynamic Detection)

1. All driver parameters are set to their Factory settings and the motor is correctly connected.
2. Users are strongly advised to disconnect the motor from any load before tuning. That is to say, the motor contains only the output shaft and connects to neither a belt nor a decelerator. Otherwise, it will be impossible to disconnect the motor from any loads. Static tuning is advised※.
3. Input the correct value for the following parameters: Motor Nominal Voltage (01-04), Motor Nominal Frequency (Pr.01-03), Motor Nominal Current (Pr.01-08), Motor Nominal Power (Pr.01-09), Motor Nominal Speed (Pr.01-10), and Motor Phases (Pr.01-11). Adjust the acceleration and deceleration time according to the motor capacity.
4. Set Pr.01-07 to “1” and press the RUN key on the digital operator to immediately run motor tuning. (Note: The motor runs).
5. After tuning, check if the motor parameters (Pr.01-13 to Pr.01-16) have been tuned and automatically added to the respective parameters.
6. Motor equivalent circuit:

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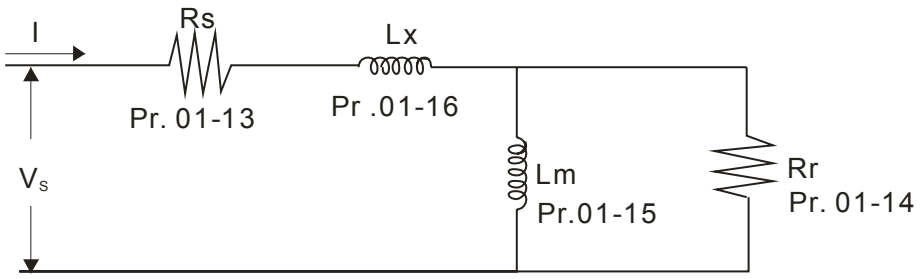

Motor equivalent circuit used by VJ

NOTE

- When running static tuning (Pr.01-07 = 2), users must input the no-load current to the motor. In general, the current is 20-50% of the nominal current.

When the parameter setting is "5", users can run the permanent motor auto tuning. By pressing the RUN key, the system will automatically run the auto tuning. Tuned values will be loaded to Pr.01-22 (Rs), Pr.01-23 and 24 (Ld and Lq), and Pr.01-25 (Permanent Motor Back Electromotive Force).

Permanent Motor Parameter AUTO-Tuning Procedures (Static Tuning)

1. All driver parameters are set to their Factory settings and the motor is correctly connected.
2. Input the correct value for the following parameters: Motor Nominal Current (Pr.01-17), Motor Nominal Power (Pr.01-18), Motor Nominal Speed (Pr.01-19), and Motor Phases (Pr.01-20). Adjust the acceleration and deceleration time according to the motor capacity.
3. Set Pr.01-07 to "5" and press the RUN key on the digital operator to immediately run motor tuning. (Note: The motor runs slightly).
4. After tuning, check if the motor parameters (Pr.01-22 to Pr.01-25) have been tuned and automatically added to the respective parameters.

When the parameter setting is "4", users can run the [Motor Pole Synchronization] and PG Origin Offset Angle auto tuning. By pressing the RUN key, the system will automatically run the auto tuning. Tuned values will be loaded to Pr.01-27.

Motor Pole Synchronization and PG Origin Offset Angle AUTO-Tuning procedures:

1. Complete the motor parameter auto-tuning in "5", or load the correct value to Pr.01-03, Pr.01-17 to Pr.01-25.
2. Users are advised to disconnect all loads of the motor before running auto-tuning.
3. Set Pr.01-07 to "4" and press the RUN key on the digital operator to immediately run motor tuning. (Note: The motor runs).
4. After the auto-tuning, check if the pole and PG origin offset angle values have been automatically loaded to Pr.01-27.

01-08 Full-load Current of Motor (IM)

Control Mode FOCPG

Unit: Ampere (A)

Factory setting: #.##

Settings 40-120% of the driver's nominal current.

When setting this parameter, users can refer to the range of the motor nominal current specified in the nameplate on the motor. Default is 90% of the driver nominal current.

Ex.: The nominal current for 7.5HP (5.5kW) is 25A, and default is 22.5A.

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The range available for adjustment is 10A to 30A.

25*40%=10 25*120%=30

01-09 Rated power of Motor (kW) (IM)

Control Mode FOCPG Factory setting: #.##

Settings 0~655.35 kW

🕮 Sets the motor nominal power. Default is the driver's nominal power.

01-10 Rated speed of Motor (rpm) (IM)

Control Mode FOCPG

Factory setting: 1710 (60Hz/4 poles)
1410 (50Hz/4 poles)

Settings 0~65535

🕮 Sets the motor nominal speed. Users must set the value according to the specifications listed on the motor nameplate.

01-11 Number of Motor Pole (IM)

Control Mode FOCPG Factory setting: 4

Settings 2~20

🕮 Sets the number of poles in the motor (even numbers only).

01-12 No-Load Current of Motor (IM)

Control Mode FOCPG Unit: Ampere (A)

Factory setting: 40

Settings 0 to Factory setting of Pr.01-08

🕮 Default is 40% of the driver nominal current.

01-13 Rs of Motor (Rs: Stator Resistance) (IM)

Control Mode FOCPG Factory setting: #.###

01-14 Rr of Motor (Rr: Rotor Resistance) (IM)

Control Mode FOCPG Factory setting: #.###

Settings 0~65.535Ω

01-15 Lm of Motor (Lm: Mutual Flux Magnitude) (IM)

Control Mode FOCPG Factory setting: #.#

01-16 Lx of Motor (Lx: Total Leak Inductive Resistance) (IM)

Control Mode FOCPG Factory setting: #.#

Settings 0~6553.5mH

01-17 Full-load Current of Motor (PM)

Control Mode FOCPM Factory setting: 0.00

Settings 0.00~655.35 Amps

🕮 Sets the nominal current according to the specifications listed on the permanent motor nameplate.

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01-18 Rated power of Motor (kW) (PM)

Control Mode FOCPM Factory setting: 0.00

Settings 0.00~655.35 kW

🕮 Sets the nominal power of the permanent motor.

01-19 Rated speed of Motor (rpm) (PM)

Control Mode FOCPM Factory setting: 0

Settings 0~65535

🕮 Sets the nominal speed according to the specifications listed on the permanent motor nameplate.

01-20 Number of Motor Pole (PM)

Control Mode FOCPM Factory setting: 6

Settings 2~20

🕮 Sets the poles of the permanent motor (even numbers only).

01-21 Permanent Motor Rotor Inertia

Control Mode FOCPM Factory setting: 0.0

Settings 0.0~6553.5 $*10^{-4}$ $kg.m^2$

01-22 Rs of Motor (Rs: Stator Resistance) (PM)

Control Mode FOCPM Factory setting: 0.000

Settings 0.000~65.535Ω

🕮 Input the phase resistance of the permanent motor.

01-23 Ld of Motor (Stator Phase Inductance) (PM)

01-24 Lq of Motor (Stator Phase Inductance) (PM)

Control Mode FOCPM Factory setting: 0.00

Settings 0.0~655.35mH

🕮 Input the phase inductance of the permanent motor. When the magnet is SPM motor, Ld=Lq; when the magnet is IPM motor, Ld≠Lq.

01-25 Ke parameter of PM Motor

Control Mode FOCPM Factory setting: 0

Settings 0~65535 V/krpm

🕮 Input the BEMF of the permanent motor.

01-26 Encoder Type

Control Mode FOCPM Factory setting: 3

Settings 0: ABZ
1: ABZ+HALL (for use on Delta motor only)
2: ABZ+HALL
3: Resolver

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🕮 Encoder & PG Card Cross-Reference Table

Parameter Setting	Encoder Type	Suitable PG Card
01-26=0	A, B, Z	EMVJ-PG01U
01-26=1,2	A, B, Z+U, V, W	EMVJ-PG01U
01-26=3	Resolver	EMVJ-PG01/02R

01-27 PG offset angle of PM Motor

Control Mode FOCPM Factory setting: 0.0

Settings 0.0~360.0°

🕮 The offset angle of the PG origin corresponding to the permanent motor.

01-28 Resolver Pole

Control Mode FOCPM Factory setting: 1

Settings 1~5

01-29 Encoder Pulse

Control Mode FOCPG FOCPM Factory setting: 1024

Settings 1~20000

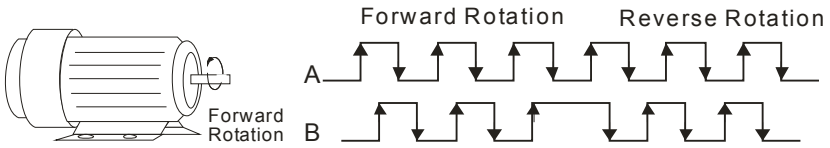
🕮 Sets the pulse per rotation (PPR) of the encoder.

01-30 Encoder Input Mode Setup

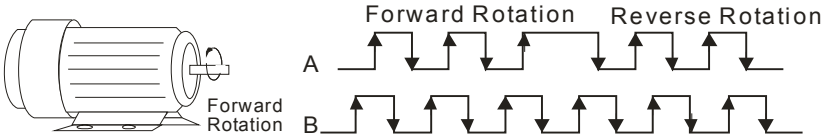
Control Mode FOCPG FOCPM Factory setting: 1

Settings 0: No function

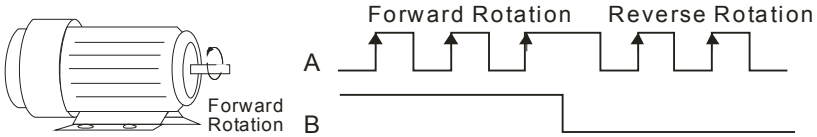
1: Phase A leads in a forward run command and phase B leads in a reverse run command.



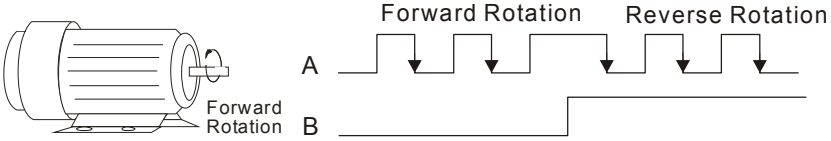
2: Phase B leads in a forward run command and phase A leads in a reverse run command.



3: Phase A is a pulse input and phase B is a direction input. (low input=reverse direction, high input=forward direction).



4: Phase A is a pulse input and phase B is a direction input. (low input=forward direction, high input=reverse direction).



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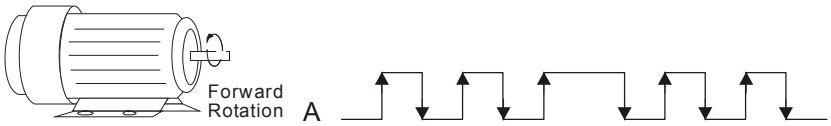
5: Single-phase input.



🕮 Correct input of pulse form brings absolute benefits to control stability.

01-31 System Control

Control Mode FOCPG FOCPM Factory setting: 1

Settings 0: No function
1: Auto tuning for ASR
2: Inertia estimate

🕮 If it is set to "1": The speed loop control gain is subject to Pr. 00-10.
If it is set to "2": Run inertia estimation as shown in Chapter 3.

↗ 01-32 Per Unit of System Inertia

Control Mode FOCPG FOCPM Factory setting: 400

Settings 1~65535 (256 = 1 per unit)

01-33 Carrier Frequency

Control Mode FOCPG FOCPM Factory setting: 5

Settings 5 KHz; 10KHz

🕮 Switch on the driver power again after setting this parameter.

🕮 The carrier frequency output from the PWM has an absolute effect on electromagnetic noise. The heat ventilation of the driver and environmental impact also has an effect. Therefore, if the ambient noise is louder than the motor noise, reducing the carrier frequency can help to reduce driver temperature. If the carrier frequency is high, although the motor can rotate quietly, the overall wiring and impact prevention should be considered.

↗ 01-34 Reserved

01-35 Hydraulic Servo Motor ID

Control Mode FOCPG FOCPM Factory setting: 0

Settings 0 : No function
16: Delta Hydraulic Servo Motor Model #ECMA-ER181BP3 (11kW220V)
17 :Delta Hydraulic Servo Motor Model #ECMA-KR181BP3 (11kW380V)
18: Delta Hydraulic Servo Motor Model #ECMA-ER221FPS (15kW220V)
19: Delta Hydraulic Servo Motor Model #ECMA-KR221FPS (15kW380V)
21: Delta Hydraulic Servo Motor Model #ECMA-KR222APS (20kW380V)

01-36 Rotation Direction Change

Control Mode FOCPG FOCPM Factory setting: 0

Settings 0: When the driver runs forward, the motor rotates counterclockwise. When the driver runs backward, the motor rotates clockwise.

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1: When the driver runs forward, the motor rotates clockwise. When the driver runs backward, the motor rotates counterclockwise.

📖 Rotation direction can only be changed when the system is shutdown. After setting the inductor parameters, the rotation direction changes immediately. Also, run the pole detection and send power to the permanent motor again.

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02 Protection Parameters

↗: The parameter can be set during operation.

↗ 02-00 Software Brake Transistor Action Reference Point Setup

Control Mode VF FOCPG FOCPM Factory setting: 380.0/760.0

Settings 230VSeries: 350.0~450.0Vdc
460VSeries: 700.0~900.0Vdc

🕮 Sets the reference point of software brake. The reference value is the DC bus voltage.

02-01 The last abnormal record.

02-02 The second to last abnormal record.

02-03 The third to last abnormal record.

02-04 The fourth to last abnormal record.

02-05 The fifth to last abnormal record.

02-06 The sixth to last abnormal record.

Settings	Control Mode VF	FOCPG	FOCPM
0: No fault record	○	○	○
1:Over-current during acceleration (ocA)	○	○	○
2:Over-current during deceleration (ocd)	○	○	○
3:Over-current during constant speed (ocn)	○	○	○
4:Ground fault (GFF)	○	○	○
5: IGBT short-circuit (occ)	○	○	○
6: Over-current at stop (ocS)	○	○	○
7: Over-voltage during acceleration (ovA)	○	○	○
8: Over-voltage during deceleration (ovd)	○	○	○
9: Over-voltage during constant speed (ovn)	○	○	○
10: Over-voltage at stop (ovS)	○	○	○
11: Low-voltage during acceleration (LvA)	○	○	○
12: Low-voltage during deceleration (Lvd)	○	○	○
13: Low-voltage during constant speed (Lvn)	○	○	○
14: Stop mid-low voltage (LvS)	○	○	○
15: Phase failure protection (PHL)	○	○	○
16: IGBT over-heat (oH1)	○	○	○
17: Heat sink over-heat (oH2)(for 40HP above)	○	○	○
18: tH1o (TH1 open: IGBT over-heat protection error)	○	○	○
19: tH2o (TH2 open: capacitance over-heat protection error)	○	○	○
20: Fan error signal output	○	○	○
21: over-load (oL) (150% 1Min)	○	○	○
22: Motor over-load (EoL1)	○	○	○
23: Reserved			
24: Motor PTC overheat (oH3)	○	○	○
25: Reserved			

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26: over-torque 1 (ot1)	○	○	○
27: over-torque 2 (ot2)	○	○	○
28: Reserved			
29: Reserved			
30: Memory write-in error (cF1)			
31: Memory read-out error (cF2)	○	○	○
32: Isum current detection error (cd0)	○	○	○
33: U-phase current detection error (cd1)	○	○	○
34: V-phase current detection error (cd2)	○	○	○
35: W-phase current detection error (cd3)	○	○	○
36: Clamp current detection error (Hd0)	○	○	○
37: Over-current detection error (Hd1)	○	○	○
38: Over-voltage detection error (Hd2)	○	○	○
39: Ground current detection error (Hd3)	○	○	○
40: Auto tuning error (AuE)			○
41: Reserved			
42: PG feedback error (PGF1)		○	○
43: PG feedback loss (PGF2)		○	○
44: PG feedback stall (PGF3)		○	○
45: PG slip error (PGF4)		○	○
46: Reserved			
47: Reserved			
48: Reserved			
49: External fault input (EF)	○	○	○
50: Emergency stop (EF1)	○	○	○
51: Reserved			
52: Password error (PcodE)	○	○	○
53: Reserved.			
54: Communication error (cE1)			
55: Communication error (cE2)	○	○	○
56: Communication error (cE3)	○	○	○
57: Communication error (cE4)	○	○	○
58: Communication Time-out (cE10)	○	○	○
59: PU time-out (cP10)	○	○	○
60: Brake chopper error (bF)	○	○	○
61~63: Reserved			
64: Safety loop error (Sry)	○	○	○
65: PGF5 hardware error			○
66: Over pressure (ovP)	○	○	○
67: Pressure feed back fault (PfbF)	○	○	○

🕮 When a fault occurs and it is necessary to stop the motor, the system will generate an event log. When the motor stops, no LvS will be recorded.

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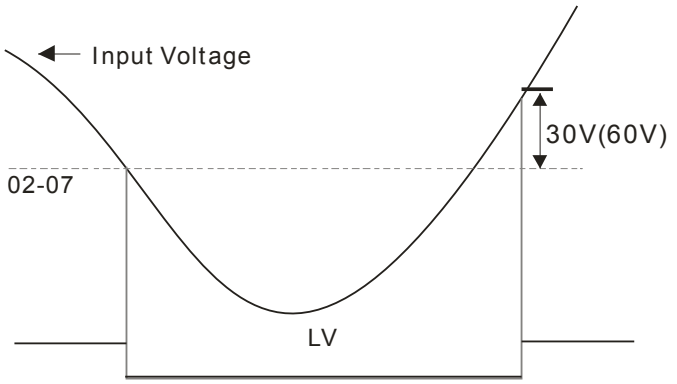
02-07 Low Voltage Reference Point

Control Mode VF FOCPG FOCPM Factory setting: 180/360

Settings 230V Models: 160~220V
460V Models: 320~440V

🕮 Sets the reference point for LV judgment.



02-08 PTC Action Select

Control Mode **VF** **FOCPG** **FOCPM** Factory setting: 0

Settings 0: Warning and continue to run.
1: Warning and stop after deceleration.
2: Warning and stop at will.

🕮 Defines the driver operation mode after the selected PTC action.

02-09 PTC Reference Point

Control Mode VF FOCPG FOCPM Factory setting: 50.0

Settings 0.0~150.0%
0.0~150.0°C

🕮 Defines the reference point of PTC actions. It should be 100% corresponding to the maximum analog input.

02-10 PTC Detection Filter Time

Control Mode VF FOCPG FOCPM Factory setting: 0.20

Settings 0.00~10.00 seconds

02-11 PTC PTC Type

Control Mode VF FOCPG FOCPM Factory setting: 0

Settings 0: Unspecified
1: KTY84

🕮 When the setting is “1”, the unit of Pr. 02-09 and 02-12 will change from “%” to “°C”.

02-12 Motor Fan Activation Reference Point

Control Mode VF FOCPG FOCPM Factory setting: 50.0

Settings 0.0~100.0%
0.0~150.0°C

🕮 When the multi-function output terminals in Pr.03-05 to Pr.03-07 are set to 45 hours, the motor fan will be

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activated or stopped at this point.

02-13 Thermoelectric Relay 1 Options

Control Mode VF FOCPG FOCPM Factory setting: 2

Settings 0: Inverter Motor
1: Standard Motor
2: No thermoelectric relay

02-14 Thermoelectric Relay 1 Action Time

Control Mode VF FOCPG FOCPM Factory setting: 60.0

Settings 30.0~600.0 seconds

🕮 To prevent motor overheating in self-cooling motors running at low speed (rpm), users can set the thermoelectric relay to limit the output power tolerance of the driver.

02-15 Output Frequency at Malfunction

Factory Setting: Read only

Settings 0.00~655.35Hz

🕮 When malfunction occurs, use can check the current frequency command. If it happens again, it will overwrite the previous record.

02-16 Output Voltage at Malfunction

Factory Setting: Read only

Settings 0.0~6553.5V

🕮 When malfunction occurs, user can check current output voltage. If it happens again, it will overwrite the previous record.

02-17 DC Voltage at Malfunction

Factory Setting: Read only

Settings 0.0~6553.5V

🕮 When malfunction occurs, user can check the current DC voltage. If it happens again, it will overwrite the previous record.

02-18 Output Current at Malfunction

Factory Setting: Read only

Settings 0.00~655.35Amp

🕮 When malfunction occurs, user can check the current output current. If it happens again, it will overwrite the previous record.

02-19 IGBT Temperature at Malfunction

Factory Setting: Read only

Settings 0.0~6553.5℃

🕮 When malfunction occurs, user can check the current IGBT temperature. If it happens again, it will overwrite the previous record.

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03 Digital/Analog I/O Parameters

↗: The parameter can be set during operation.

03-00 Multi-function Input Command 3 (MI3)

03-01 Multi-function Input Command 4 (MI4)

03-02 Multi-function Input Command 5 (MI5)

Control Mode VF FOCPG FOCPM Factory setting: 0

Settings 0: No function
44: Injection signal input
45: Combination/Diversion signal input

- When it is set to "0", the motor is operated by pressure control throughout the process.
- When it is set to "44", flow control is activated when the pressure feedback is lower than the pressure stabilization zone (see the explanation for Pr.00-26). When entering the pressure stabilization zone, pressure control will be activated.
- When it is set to "45", the combination (OFF) or diversion (ON) function is activated. Please refer to the description on tuning in Chapter 3.

↗ 03-03 Digital Input Response Time

Control Mode VF FOCPG FOCPM Factory setting: 0.005

Settings 0.001~ 30.000 sec

- This parameter is used for digital input terminal signal delay and confirmation. The delay time is confirmation time to prevent some uncertain interferences that would result in error (except for the counter input) in the input of the digital terminals. Under this condition, confirmation for this parameter could be improved effectively, but the response time will be somewhat delayed.

↗ 03-04 Digital Input Operation Direction

Control Mode VF FOCPG FOCPM Factory setting: 0

Settings 0~65535

- This parameter is used to set the input signal level.
- When bit 0 is the SON terminal, bit 2 is the EMG terminal, and bit 3 is the RES terminal, bits 4-6 correspond to MI3-MI5.

↗ 03-05 Multi-function Output 1 (Relay 1)

Control Mode VF FOCPG FOCPM Factory setting: 11

↗ 03-06 Multi-function Output 2 (MO1)

Control Mode VF FOCPG FOCPM Factory setting: 0

↗ 03-07 Multi-function Output 3 (MO2)

Control Mode VF FOCPG FOCPM Factory setting: 0

Settings 0: No function.
1: Operation Indication
9: Hybrid Servo Controller is ready
11: Malfunction indication

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44: Ram pump flow switch signal

45: Motor fan control signal

03-08 Multi-function Output Direction

Control Mode VF FOCPG FOCPM Factory setting: 0

Settings 0~65535

🕮 This parameter is bit setting. If the bit is 1, the multi-function output terminal will be act with opposite direction. For example, if Pr.03-05 is set to 1 and forward bit is 0, Relay 1 will be ON when the drive is running and OFF when the drive is stop.

03-09 Low-pass Filter Time of Keypad Display

Control Mode VF FOCPG FOCPM Factory setting: 0.010

Settings 0.001~65.535seconds

🕮 It is used to lower the blinking frequency of LCD display.

03-10 Pressure Feedback Maximum Output Voltage

Control Mode VF FOCPG FOCPM Factory setting: 10

Settings 5~10 V

03-11 Pressure Feedback Minimum Output Voltage

Control Mode VF FOCPG FOCPM Factory setting: 0

Settings 0~1V

🕮 Sets the output voltage type of pressure feedback.

03-12 Reserved

03-13 Combination Master/Slave Selection

Control Mode VF FOCPG FOCPM Factory setting: 0

Settings 0: No function

1: Master

2: Slave

🕮 For stand-alone models, the factory setting is “0”

🕮 The factory setting for the master is “1” and slave is “2”`

03-14 Slave to Master Flow Ratio

Control Mode VF FOCPG FOCPM Factory setting: 100.0

Settings 0.0~65535.5 %

🕮 Sets the ratio for the master only.

🕮 Sets the percentage of slave flow in the master flow for combination systems.

Ex. If the slave flow is 60L/min and the master flow is 40L/min, set parameter to 60/40*100%=150%.

If there are two or more motors working in combination, the flow of all slaves should be the same. If the total flow of all three machines is 200L/min and the master flow is 40L/min, the flow of the two slaves is 80L/min. Set parameter to 160/40=400%.

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03-15 Source Setup of the Master Frequency Command

Control Mode VF FOCPG FOCPM Factory setting: 0

Settings 0: Digital keypad
1: RS485 serial communication
2~5: Reserved

- This must be worked with EMVJ-MF01. Please refer to the tuning description in Chapter 3.
- For combination systems, frequency commands are sent to the slave over the RS485 communication port. In this case, the parameter is "1".

03-16 Slave Motor Reverse Rotation Pressure Relief Torque Limit

Control Mode VF FOCPG FOCPM Factory setting: 0

Settings 0~500%

- Sets the torque limit of the slave running reversely.

03-17 Reserved

03-18 Transmission Fault Treatment

Control Mode VF FOCPG FOCPM Factory setting: 0

Settings 0: Warn and keep operation
1: Warn and ramp to stop
2: Warn and coast to stop
3: No action and no display

- Sets the handling mode of the Hybrid Servo Controller when there is a communication error, such as time out or fault.

03-19 Time Out Detection

Control Mode VF FOCPG FOCPM Factory setting: 0.0

Settings 0.0~100.0 sec

- Sets the timeout time in the communication with the keypad.

03-20 Start-up Display Selection

Control Mode VF FOCPG FOCPM Factory setting: 0

Settings 0: Display the frequency command value (LED F)
1: Display the actual output frequency (LED H)
2: Multifunctional display, see Pr.00-04
3: Display the output current (A)

- Sets the system startup screen. The options defined by users are based on the settings in Pr.00-04.

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Chapter 5 Methods of Anomaly Diagnosis

5-1 System Troubleshooting
5-2 Signal Display of Hybrid Servo Controller
5-2-1 Indicator Display
5-2-2 Error Messages Displayed on Digital Operation Panel KPVJ-LE01
5-3 Steps of Troubleshooting for Hybrid Servo Controller
5-3-1 Over current (OC)
5-3-2 Ground fault (GFF)
5-3-3 Over voltage (OV)
5-3-4 Low voltage (Lv)
5-3-5 Overheat (OH1)
5-3-6 Overload (OL)
5-3-7 Phase loss in power supply (PHL)
5-3-8 Resolutions for electromagnetic noise and induction noise
5-3-9 Environment and facilities for installation

The Hybrid Servo Controller is capable of displaying warning messages such as over voltage, low voltage, and over current and equipped with the protection function. Once any malfunction occurs, the protection function will be activated and the Hybrid Servo Controller will stops its input, followed by the action of the anomaly connection point and stopping of the servo oil pump. Please refer to the cause and resolution that corresponds to the error message displayed by the Hybrid Servo Controller for troubleshooting. The error record will be stored in the internal memory of the Hybrid Servo Controller (up to the most recent six error messages) and can be read by the digital operation panel or communication through parametric readout.

- ☑ Upon the occurrence of anomaly, wait for five seconds after the anomaly is resolved before pressing the RESET key.
- ☑ For Hybrid Servo Controllers with power ≦ 22kW, wait for five minutes after the power is turned off and for ten minutes for models with power ≧ 30kW. Verify that the charging indicator is off. Measure the DC voltage between terminals ⊕~⊖, which should be below DC25V before opening the machine cover and starting the inspection.

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5-1 System Troubleshooting

Failure to establish pressure	☑ Check if hybrid servo motor is running ☑ Check if the coupling is loose or breaking off ☑ Check for any leak in the oil line
Oil tank is not running	☑ Check if hybrid servo motor is running ☑ Check if the pressure command and flow rate command are sent through the operation panel of Hybrid Servo Controller or multimeter
Rotation speed of hybrid servo motor exceeds 500rpm during pre-pressurizing or hold up time	☑ Check for any leak in the oil line ☑ Check for any internal leak in the oil pump. Send the unit back to manufacturer for repair if confirmed

5-2 Signal Display of Hybrid Servo Controller

5-2-1 Indicator Display

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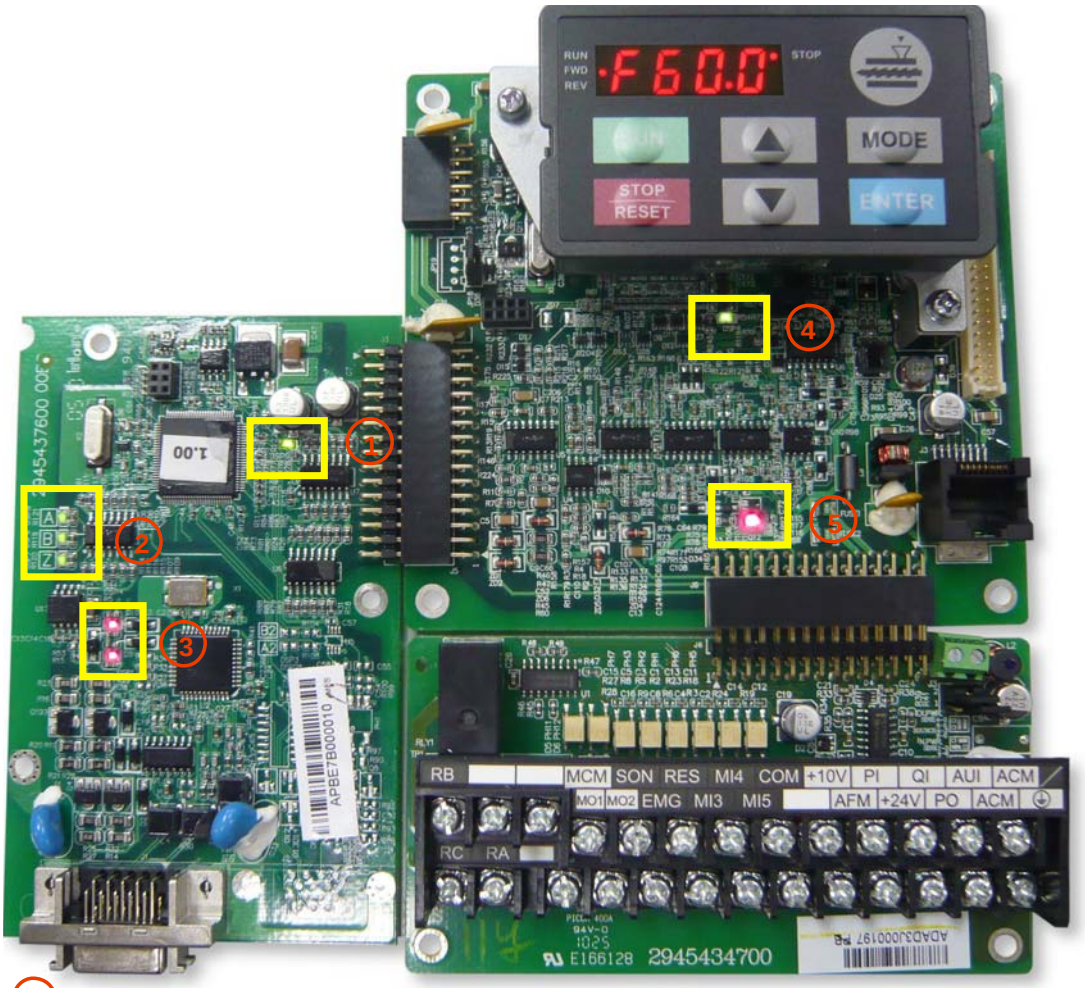

1. Indicator of PG card power
2. Indicator of Encoder feedback
3. Warning indicator
   When the sin or cos phase voltage is lower than required values in the rotational transformer, the warning indicator will be on. Please check if the encoder wire is connected correctly. If it happens in operation, please check for any interference.
4. Power indicator
5. Power indicator

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5-2-2 Error Messages Displayed on Digital Operation Panel KPVJ-LE01

Display Code	Description of Anomaly	Troubleshooting
	Over current occurs in acceleration; output current exceeds by three times the rated current of the frequency inverter	Check if the insulation of the wire from U-V-W to the hybrid servo motor is bad Check if the hybrid servo motor is stalled Replace with the Hybrid Servo Controller with larger output capacity
	Over current occurs in deceleration; output current exceeds by three times the rated current of the frequency inverter	Check if the insulation of the wire from U-V-W to the hybrid servo motor is bad Check if the hybrid servo motor is stalled Replace with the Hybrid Servo Controller with larger output capacity
	Over current occurs when running; output current exceeds by three times the rated current of the frequency inverter	Check if the insulation of the wire from U-V-W to the hybrid servo motor is bad Check if the hybrid servo motor is stalled Replace with the Hybrid Servo Controller with larger output capacity
	Over current occurs when the system is off. Unusual hardware circuit by current detection	Send back to manufacturer for repair
	Shorting of top and bottom bridges in IGBT module are detected by Hybrid Servo Controller	Send back to manufacturer for repair
	Over voltage occurs on the internal DC high voltage side detected by Hybrid Servo Controller in acceleration	230: DC 450V 460V: DC 900V Check if the input voltage is within the range of voltage rating of Hybrid Servo Controller and monitor for any occurrence of surge voltage For Hybrid Servo Controller with power below 22kW, the issue can be resolved by adjusting the software brake action level in Pr.02-00 For Hybrid Servo Controller with power above 22kW, the issue can be resolved by adjusting the action level in the brake unit (詳細說明，請參閱附錄 B-6 煞車單元)
	Over voltage occurs on the internal DC high voltage side detected by Hybrid Servo Controller in deceleration	
	Over voltage occurs on the internal DC high voltage side detected by Hybrid Servo Controller when running	
	Over voltage occurs when the system is off. Unusual hardware circuit by current detection	Check if the input voltage is within the range of voltage rating of Hybrid Servo Controller and monitor for any occurrence of surge voltage
	The DC voltage of Hybrid Servo Controller is lower than the setting in Pr.02-07 in acceleration	Check if the voltage of input power is normal Check if there is any sudden heavy load Adjust the low voltage level in Pr.02-07
	The DC voltage of Hybrid Servo Controller is lower than the setting in Pr.02-07 in deceleration	
	The DC voltage of Hybrid Servo Controller is lower than the setting in Pr.02-07 when running at constant speed	
	The DC voltage of Hybrid Servo Controller is lower than the setting in Pr.02-07 when off	
	Phase los protection	Check if only single phase power is sent or phase los occurs for three phase models For models with 40HP and above, check if

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		the AC side fuse is blown
	Ground wire protection, applies when Hybrid Servo Controller detects the output is grounded and the ground current is higher than its rated value by over 50%. Note that this protection is only for Hybrid Servo Controller and not for human.	Check the wire of hybrid servo motor is shorted or grounded Check if IGBT power module is damaged Check if the output side wire has bad insulation
	Overheating of IGBT detected by Hybrid Servo Controller, exceeding the protection level 7.5~15HP: 90℃ 20~100HP: 100℃	Check if environment temperature if too high Check if there is any foreign object on the heat sink and if the fan is running Check if there is sufficient space for air circulation for Hybrid Servo Controller
	Over heating of heat sink detected by Hybrid Servo Controller, exceeding the protection level (90℃)	Check if environment temperature if too high Check if there is any foreign object on the heat sink and if the fan is running Check if there is sufficient space for air circulation for Hybrid Servo Controller
	Fan failure	Check if the fan is stalled Send back to manufacturer for repair
	Output current exceeds the maximum capacity of Hybrid Servo Controller	Check if the motor is overloaded Increase the output capacity of Hybrid Servo Controller
	Servo motor overloaded	Change the product conditions
	DC Fuse blown on (FUSE), for models below (including) 30HP	Check if the transistor module fuse is bad Check if the load side is shorted
	Abnormal memory write in	Press RESET key to return all parameters to factory default values If the above does not work, send back to manufacturer for repair
	Abnormal memory readout	
	Detection of abnormal output of three-phase total current	Turn off the power and restart. If the same problem persists, send back to manufacturer for repair
	Detection of abnormal current in U phase	
	Detection of abnormal current in V phase	
	Detection of abnormal current in W phase	
	When external EF terminals are closed, Hybrid Servo Controller stops its output	Troubleshoot and press ”RESET”
	When external EMG terminal is not connected to the heating switch of hybrid servo motor or the motor is overheated (130℃), Hybrid Servo Controller stops its input	Troubleshoot and press ”RESET”
	Abnormal brake crystal detected by Hybrid Servo Controller	Press RESET. If the display still shows “bF”, please send the unit back to manufacturer for repair

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	Abnormal in OH1 hardware wire	Send back to manufacturer for repair
	Abnormal in OH2 hardware wire	Send back to manufacturer for repair
	Abnormal cc protection hardware wire	Turn off the power and restart. If the same problem persists, send back to manufacturer for repair
	Abnormal oc protection hardware wire	
	Abnormal ov protection hardware wire	
	Abnormal GFF protection hardware wire	
	Open circuit of PG feedback	Check the PG feedback wiring
	Stalled PG feedback	Check the PG feedback wiring Check PI gain and the settings for acceleration/deceleration are suitable Send back to manufacturer for repair
	Abnormal PG slip	
	Incorrect PG card information	Check if the settings of Pr.01-26 match those in the installed PG card. If so, please send back to manufacturer for repair
	Abnormal installation or action of JP18, the safety loop card/control board pin	Check if the safety loop card is installed correctly on the control board and if the output action is normal Check if pin JP18 is inserted into the wrong position on the control board
	Pressure is too high	Check if the pressure sensor is working properly Adjust pressure PI control Pr.00-20~00-37
	Open circuit of pressure feedback	Check if the wiring of pressure sensor is correct Check if the pressure sensor signal is below 1V

Alarm reset

Once the issue that tripped the system and triggers the alarm is eliminated, one can resume the system to normal status by pressing the Reset key on the panel (as shown in the figure) to set the external terminal to "Anomaly reset command" and sending the command by turning on the terminal or via communication. Before any anomaly alarm is resolved, make sure the operation signal is at open circuit status (OFF) to avoid immediate machine running upon anomaly reset that may case mechanical damage or personnel casualty.

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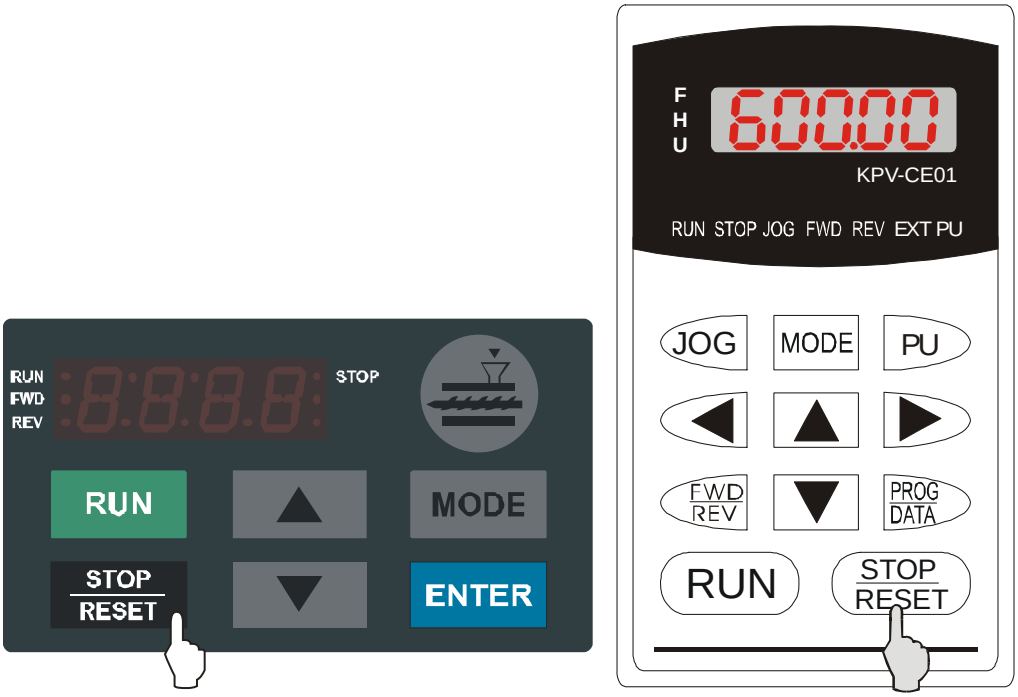

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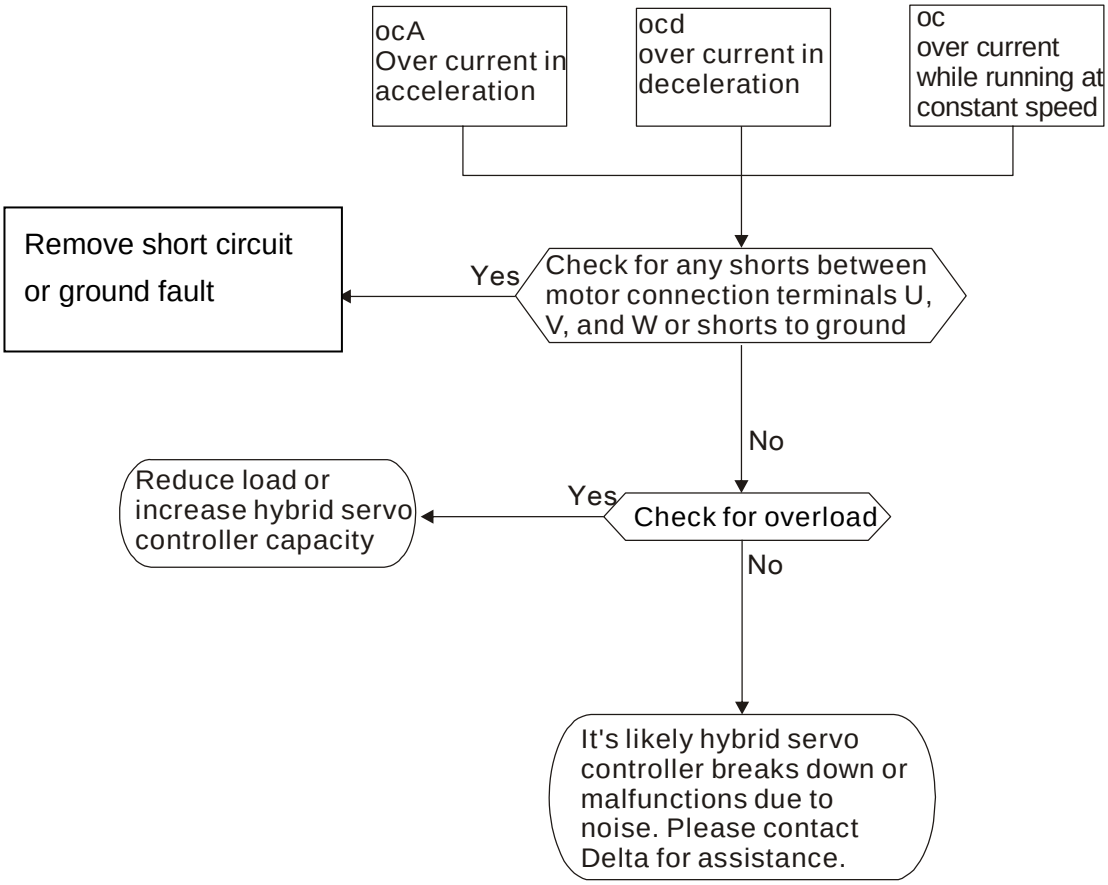
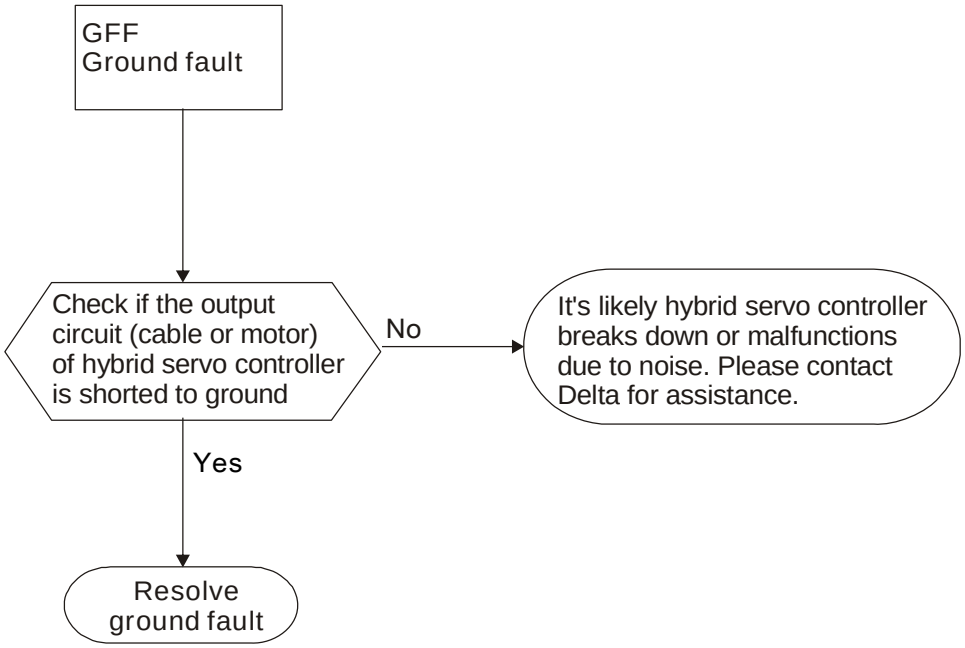
5-3 Steps of Troubleshooting for Hybrid Servo Controller

5-3-1 Over Current (OC)


ocA
Over current in acceleration
ocd
over current in deceleration
oc
over current while running at constant speed
Remove short circuit or ground fault
Yes
Check for any shorts between motor connection terminals U, V, and W or shorts to ground
No
Reduce load or increase hybrid servo controller capacity
Yes
Check for overload
No
It's likely hybrid servo controller breaks down or malfunctions due to noise. Please contact Delta for assistance.

5-3-2 Ground Fault (GFF)


GFF
Ground fault
Check if the output circuit (cable or motor) of hybrid servo controller is shorted to ground
No
It's likely hybrid servo controller breaks down or malfunctions due to noise. Please contact Delta for assistance.
Yes
Resolve ground fault

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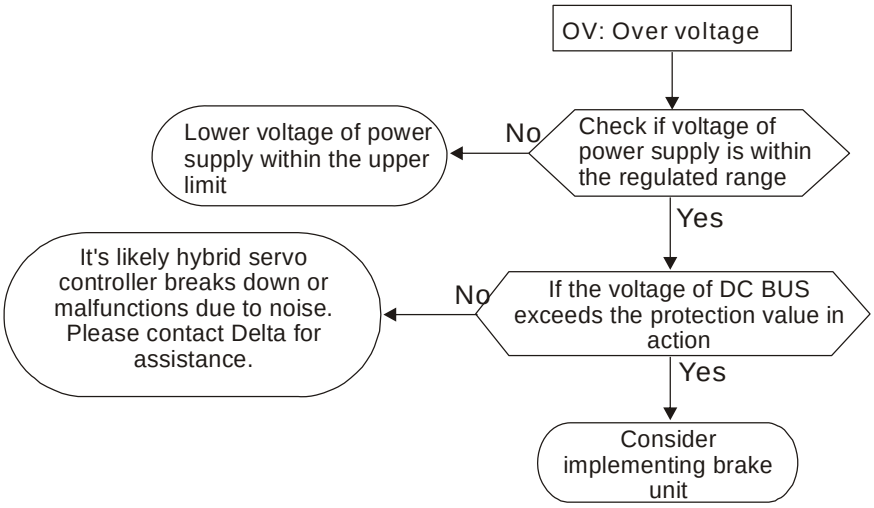
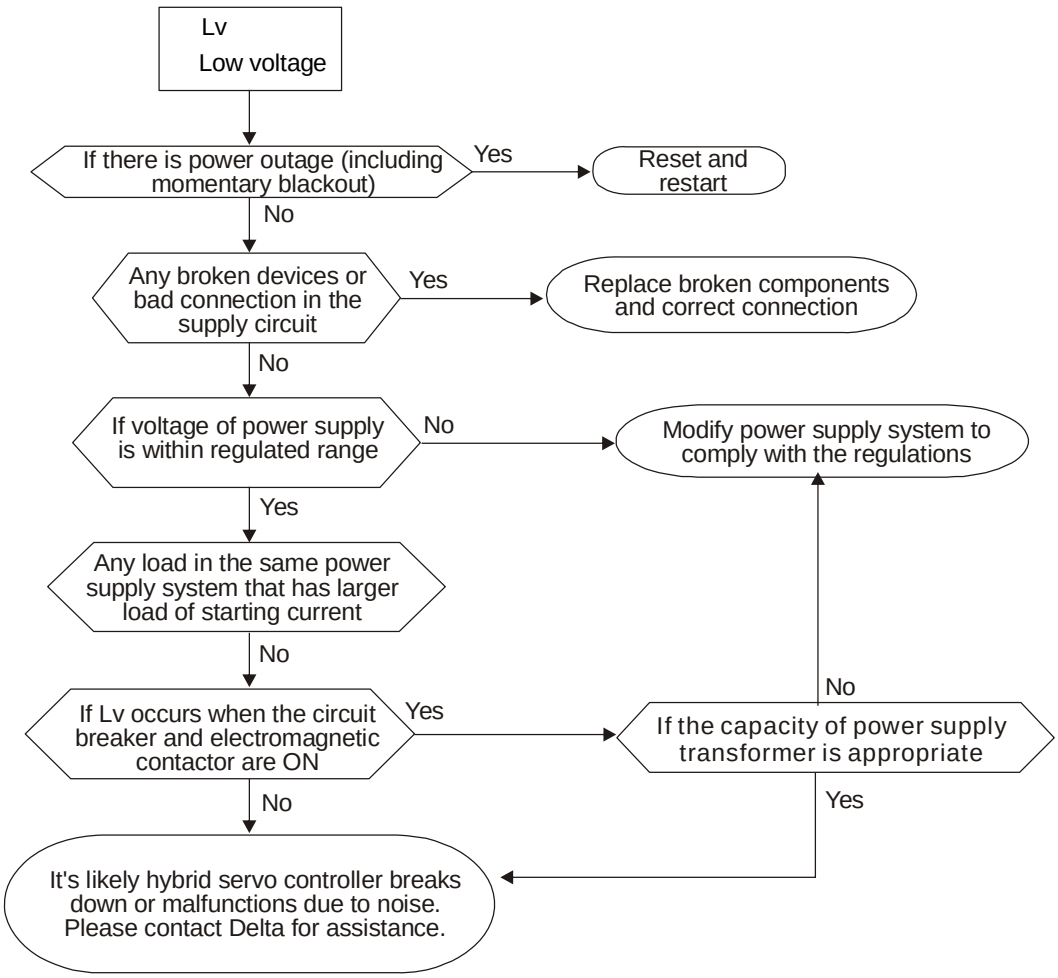
5-3-3 Over Voltage (ov)


OV: Over voltage
Check if voltage of power supply is within the regulated range
No
Lower voltage of power supply within the upper limit
Yes
If the voltage of DC BUS exceeds the protection value in action
No
It's likely hybrid servo controller breaks down or malfunctions due to noise. Please contact Delta for assistance.
Yes
Consider implementing brake unit

5-3-4 Low Voltage (Lv)


Lv
Low voltage
If there is power outage (including momentary blackout)
Yes
Reset and restart
No
Any broken devices or bad connection in the supply circuit
Yes
Replace broken components and correct connection
No
If voltage of power supply is within regulated range
No
Modify power supply system to comply with the regulations
Yes
Any load in the same power supply system that has larger load of starting current
No
If Lv occurs when the circuit breaker and electromagnetic contactor are ON
Yes
If the capacity of power supply transformer is appropriate
No
Yes
No
It's likely hybrid servo controller breaks down or malfunctions due to noise. Please contact Delta for assistance.

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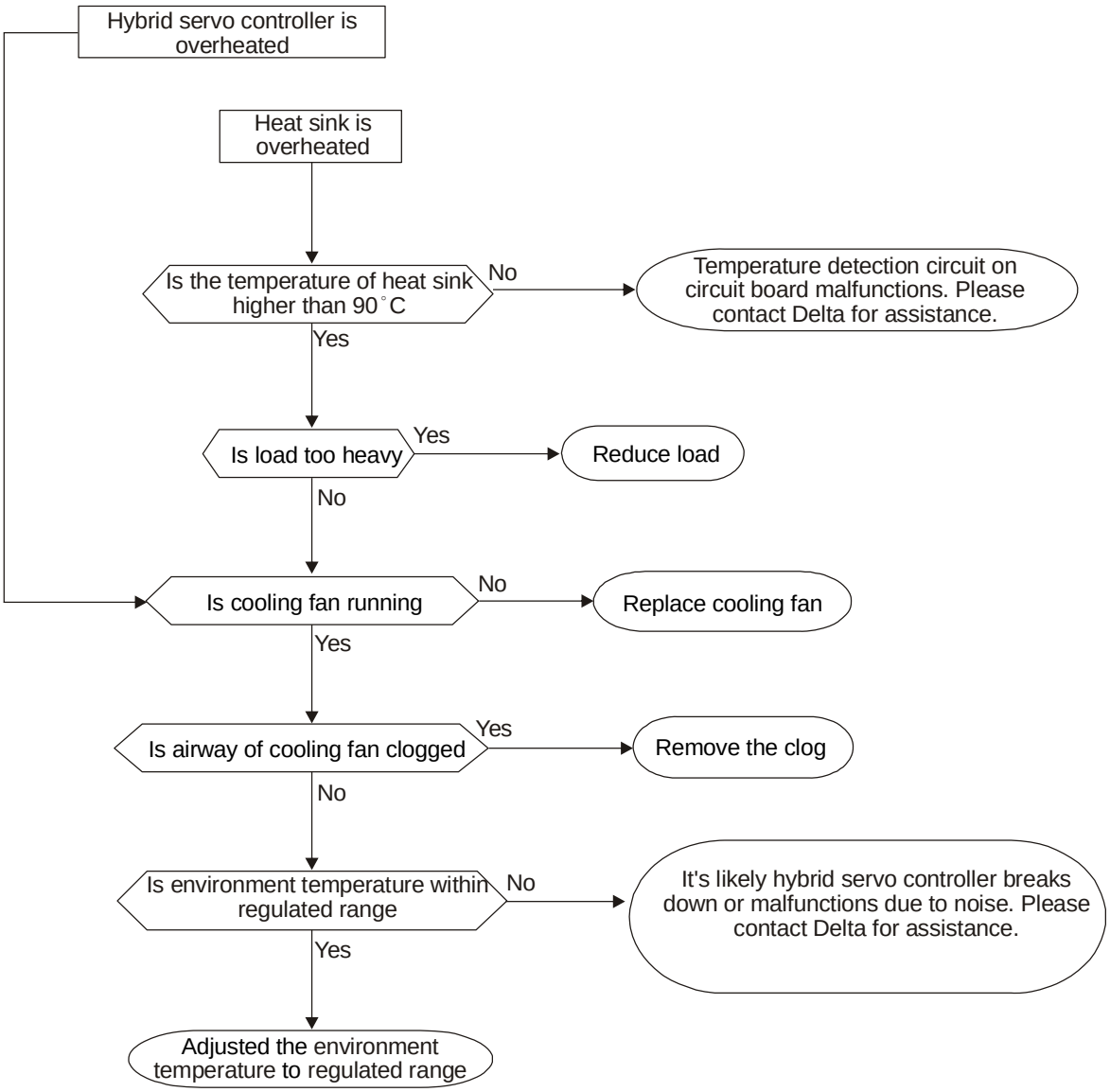
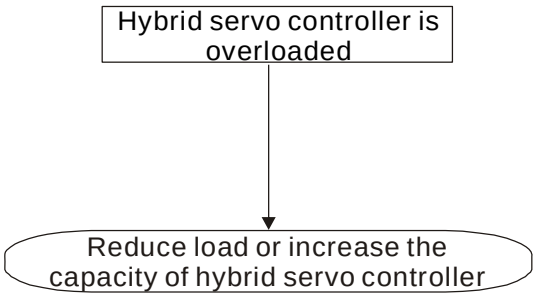
5-3-5 Over Heat (OH)


Hybrid servo controller is overheated
Heat sink is overheated
Is the temperature of heat sink higher than 90°C
No
Temperature detection circuit on circuit board malfunctions. Please contact Delta for assistance.
Yes
Is load too heavy
Yes
Reduce load
No
Is cooling fan running
No
Replace cooling fan
Yes
Is airway of cooling fan clogged
Yes
Remove the clog
No
Is environment temperature within regulated range
No
It's likely hybrid servo controller breaks down or malfunctions due to noise. Please contact Delta for assistance.
Yes
Adjusted the environment temperature to regulated range

5-3-6 Overload (oL)



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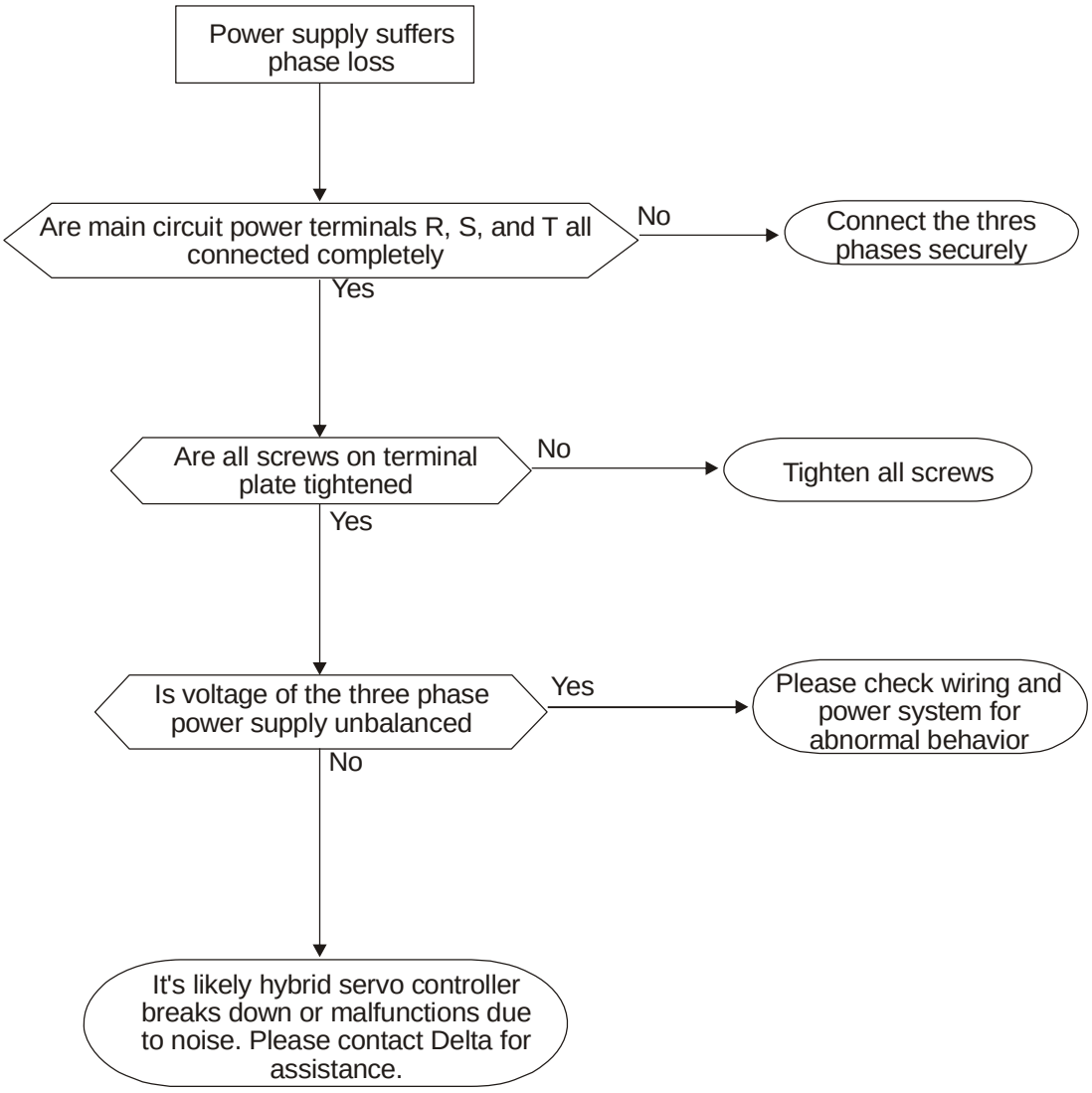
5-3-7 Phase Loss (PHL)


Power supply suffers phase loss
Are main circuit power terminals R, S, and T all connected completely
No
Connect the thres phases securely
Yes
Are all screws on terminal plate tightened
No
Tighten all screws
Yes
Is voltage of the three phase power supply unbalanced
Yes
Please check wiring and power system for abnormal behavior
No
It's likely hybrid servo controller breaks down or malfunctions due to noise. Please contact Delta for assistance.

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5-3-8 Electromagnetic/Induction Noise

If there exist noise sources around Hybrid Servo Controller, they will affect Hybrid Servo Controller through radiation or the power lines, leading to malfunction of control loop and causing tripping or even damage of Hybrid Servo Controller. One natural solution is to make Hybrid Servo Controller more immune to noise. However, it is not economical and the improvement is limited. It is best to resort to methods that achieve improvements outside Hybrid Servo Controller.

1. Add surge killer on the relay or contact to suppress switching surge between ON/OFF.
2. Shorten the wiring length of the control circuit or serial circuit and separate from the main circuit wiring.
3. Comply with the wiring regulation for those shielded wire and use isolation amplifier for long wire.
4. The ground terminal of Hybrid Servo Controller must be connected to ground by following the associated regulations. It must have its own ground connection and cannot share with electrical welder and other power equipments.
5. Insert noise filter to the input terminal of Hybrid Servo Controller to prevent the noise entering from the power lines.

In a word, three-level solutions for electromagnetic noise are “no product”, “no spread” and “no receive”.

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5-3-9 Environment and Facilities for Installation

The Hybrid Servo Controller is a device for electronic components. Detailed descriptions of the environment suitable for its operation can be found in the specifications. If the listed regulations cannot be followed for any reason, there must be corresponding remedial measures or contingency solutions.

1. To prevent vibration, anti-vibration spacer is the last choice. The vibration tolerance must be within the specification. The vibration effect is equal to the mechanical stress and it cannot occur frequently, continuously or repeatedly to prevent damaging AC motor drive.

2. Store in a clean and dry location free from corrosive fumes/dust to prevent rustiness, poor contact. It also may cause short by low insulation in a humid location. The solution is to use both paint and dust-proof. For particular occasion, use the enclosure with whole-seal structure.

3. The environment temperature must be just right. If the temperature is too high or too low, the lifetime and action reliability of electronic components will be affected. For semiconductor devices, once the conditions exceed the rated values, consequences associated with “damage” are expected. As a result, in addition to providing cooler and shades that block the direct sunlight that are aimed to achieve required environment temperature, it is also necessary to perform cleaning and spot check the air filter in the storage tray of Hybrid Servo Controller and the angle of cooling fan. Moreover, the microcomputer may not work at extremely temperature, space heater is needed for machines that are installed and operated in cold regions.

4. Avoid moisture and occurrence of condensation. If the Hybrid Servo Controller is expected to be shut down for an extended period of time, be careful not to let condensation happen once the air conditioning is turned off. It is also preferred that the cooling equipment in the electrical room can also work as a dehumidifier.

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Chapter 6 Maintenance

Maintenance and Inspections

The AC motor drive has a comprehensive fault diagnostic system that includes several different alarms and fault messages. Once a fault is detected, the corresponding protective functions will be activated. The following faults are displayed as shown on the AC motor drive digital keypad display. The six most recent faults can be read from the digital keypad or communication.

The AC motor drive is made up by numerous components, such as electronic components, including IC, resistor, capacity, transistor, and cooling fan, relay, etc. These components can't be used permanently. They have limited-life even under normal operation. Preventive maintenance is required to operate this AC motor drive in its optimal condition, and to ensure a long life.

Basic check-up items to detect if there were any abnormalities during operation are:

CAUTION	☑ Wait for five minutes after the Hybrid Servo Controller with power ≦ 22kW is disconnected with power supply and wait for ten minutes for units with power ≧ 30kW and verify that the charging indicator is off. Measure to make sure that the DC voltage between terminals ⊕ ~ ⊖ is lower than DC25V before starting the inspection. ☑ Only qualified personnel can install, wire and maintain AC motor drives. Please take off any metal objects, such as watches and rings, before operation. And only insulated tools are allowed. ☑ Never attempt any alternation of the Hybrid Servo Controller. ☑ Make sure that installation environment comply with regulations without abnormal noise, vibration and smell.

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Maintenance and Inspections

Before the check-up, always turn off the AC input power and remove the cover. Wait at least 10 minutes after all display lamps have gone out, and then confirm that the capacitors have fully discharged by measuring the voltage between DC+ and DC-. The voltage between DC+ and DC-should be less than 25VDC.

Ambient environment

Check Items	Methods and Criterion	Maintenance Period		
		Daily	Half year	One Year
Check the ambient temperature, humidity, vibration and see if there are any dust, gas, oil or water drops	Visual inspection and measurement with equipment with standard specification	○		
If there are any dangerous objects	Visual inspection	○		

Actuation Oil

Check Items	Methods and Criterion	Maintenance Period		
		Daily	Half year	One Year
If oil is sufficient	Visual inspection	○		
If the oil temperature is below 60°C (recommended temperature is 15°C~ 50°C)	By thermometer	○		
If the oil color is normal	Visual inspection		○	
Replace Actuation Oil regularly				○

Servo Oil Pump

Check Items	Methods and Criterion	Period of inspection		
		Daily	Half year	One Year
If the set screws of Servo Oil Pump are loose	Visual inspection		○	
If the coupling screws of Servo Oil Pump are loose	Visual inspection		○	
If the cooling fan of hybrid servo motor is running normally and the air flow is sufficient	Visual inspection		○	
Clean the cooling fan of hybrid servo motor regularly				○

Voltage

Check Items	Methods and Criterion	Maintenance Period		
		Daily	Half year	One Year
Check if the voltage of main circuit and control circuit is correct	Measure with multimeter with standard specification	○		

Keypad

Check Items	Methods and Criterion	Period of inspection		
		Daily	Half year	One Year
Is the display clear for reading	Visual inspection	○		
Any missing characters		○		

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Mechanical parts

Check Items	Methods and Criterion	Period of inspection		
		Daily	Half year	One Year
If there is any abnormal sound or vibration	Visual and aural inspection		○	
If there are any loose screws	Tighten the screws		○	
If any part is deformed or damaged	Visual inspection		○	
If there is any color change by overheating	Visual inspection		○	
If there is any dust or dirt	Visual inspection		○	

Main Circuit Part

Check Items	Method of Inspection	Period of inspection		
		Daily	Half year	One Year
Have any bolts become loose or missing?	Tighten	○		
Is there any distortion, cracking, breaking of machine and insulation or discoloration due to overheating and aging?	Visual inspection		○	
Are there any dust or stains?	Visual inspection		○	

Main Circuit ～Terminals & Wiring

Check Items	Method of Inspection	Period of inspection		
		Daily	Half year	One Year
Is there any discoloration and distortion of terminals and copper plate due to overheating?	Visual inspection		○	
Is there any breaking and discoloration of the protection layer of wires?	Visual inspection		○	

Main Circuit～Terminal Unit

Check Items	Method of Inspection	Period of inspection		
		Daily	Half year	One Year
Is there any damage?	Visual inspection	○		

Main Circuit～Filter Capacitor

Check Items	Method of Inspection	Period of inspection		
		Daily	Half year	One Year
Is there any leakage, discoloration, crack, and buckling of exterior cover?	Visual inspection	○		
Is the safety valve out? Is there any obvious expansion of the valve?	Visual inspection	○		
Measure the electrostatic capacity according to the actual requirements		○		

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Main Circuit～Resistor

Check Items	Method of Inspection	Period of inspection		
		Daily	Half year	One Year
Is there any odor from overheating and breaking of insulation?	Visual inspection and listening	○		
Is there any open circuit?	Visual inspection	○		
Is there any damage of the connection end?	Measure by hand-held multimeter	○		

Main Circuit～Transformer & Reactor

Check Items	Method of Inspection	Period of inspection		
		Daily	Half year	One Year
Any unusual vibration and odor?	Visual inspection and listening	○		

Main Circuit～Electromagnetic Contactor & Relay

Check Items	Method of Inspection	Period of inspection		
		Daily	Half year	One Year
Is there any sound of vibration while running?	Aural inspection	○		
Is the connection contact is good?	Visual inspection	○		

Control Circuit～Control Printed Circuit & Connector

Check Items	Method of Inspection	Period of inspection		
		Daily	Half year	One Year
Has the screw and connector become loose?	Tighten		○	
Is there any unusual odor and discoloration?	By smelling and visual		○	
Are there any cracks, breaking, distortion, and apparent rust?	Visual inspection		○	
Are there any leaks and signs of distortion of the capacitor?	Visual inspection		○	

Cooling fan of cooling system

Check Items	Method of Inspection	Period of inspection		
		Daily	Half year	One Year
Is there any unusual sound and vibration?	Visual, aural inspection and turn the fan with hand (turn off the power before operation) to see if it rotates smoothly		○	
Have any bolts become loose?	Tighten		○	
Is there any discoloration due to overheating?	Visual inspection		○	

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Cooling System～Air Duct

Check Items	Method of Inspection	Period of inspection		
		Daily	Half year	One Year
Is the heatsink, the inlet and exhaust unclogged and free of foreign objects?	Aural inspection		○	

NOTE

To treat the contaminated spots, please wipe clean with cloths that is chemically neutral. Use air purifier to remove the dust.

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Appendix A. Instructions of Product Packaging

A-1 Descriptions of Product packaging

A-2 Detailed List of Product Packaging

☑ This product is made by a manufacturing process with strict quality control. If the product is damaged in the delivery by external force or crushing, please contact your local agents.

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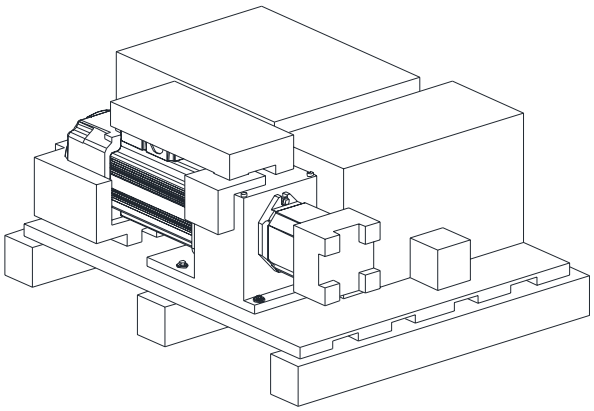
A-1 Descriptions of Product Packaging

Remove the packaging of the external box

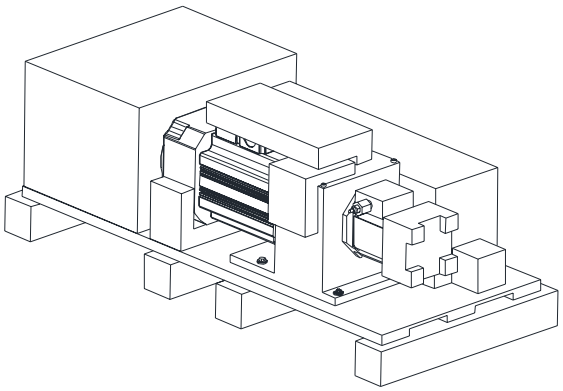
Models:

HES063H23A; HES080G23A; HES080H23A;
HES100G23A; HES100H23A;
HES063G43A;HES063H43A; HES080G43A;
HES080H43A; HES100G43A; HES100H43A;



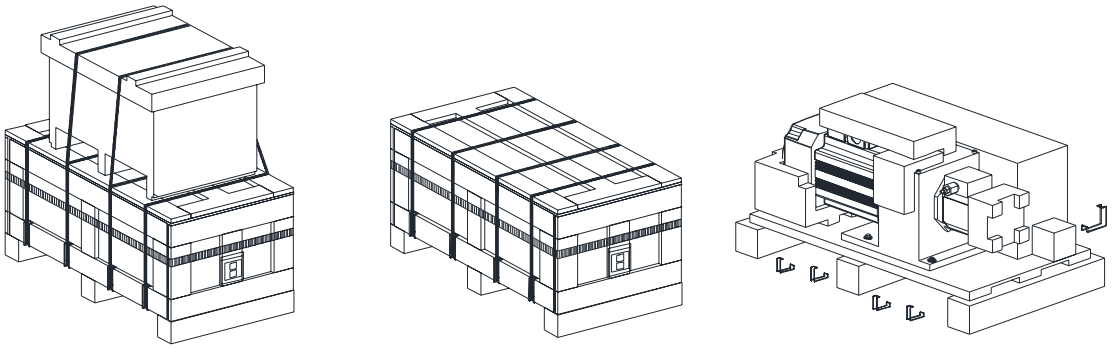
Models:

HES125G23A; HES125G43A;



Models:

HES125H23A; HES160G23A;
HES125H43A; HES160G43A; HES160H43A; HES200G43A



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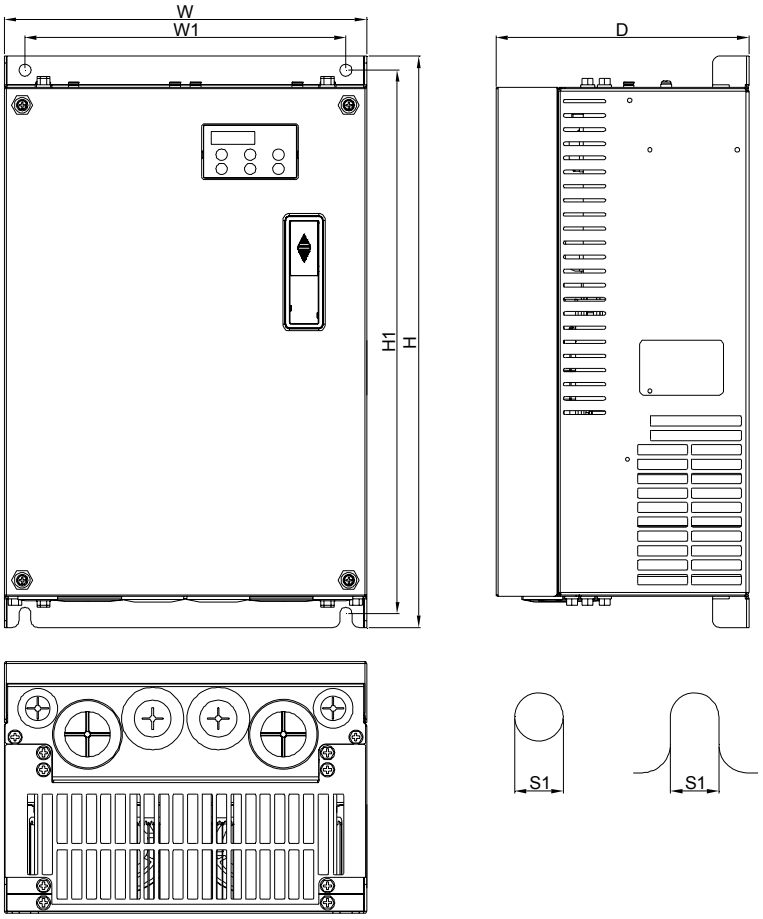
A-2 Detailed List of Product Packaging

HES063H23A

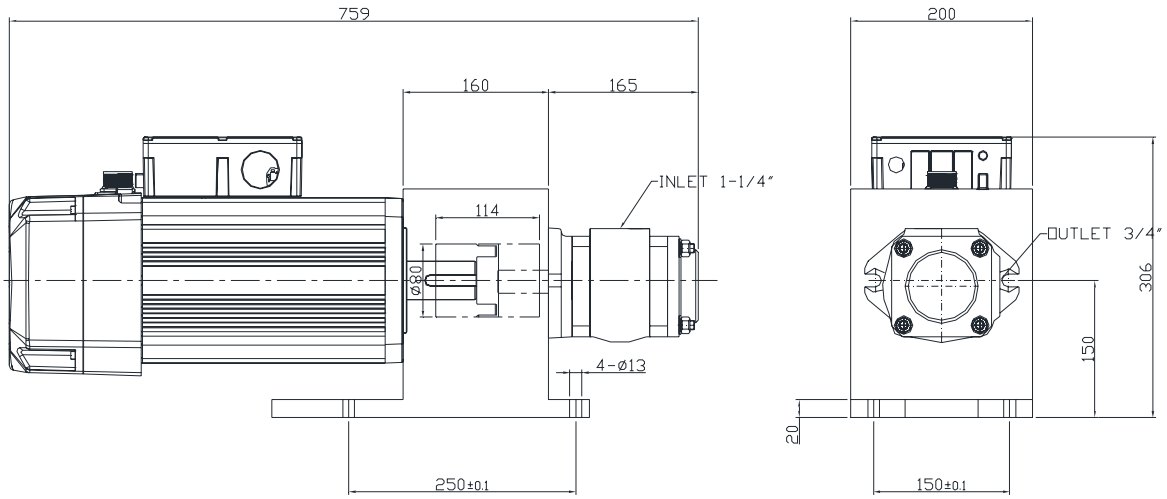
1 Servo controller VFD110VL23A-J



Unit: mm[inch]

W	W1	H	H1	H2	H3	D	Ø	Ø1	Ø2	Ø3
235 [9.25]	204 [8.03]	350 [13.78]	337 [13.27]	320 [12.60]	-	136 [5.35]	6.5 [0.26]	-	34 [1.34]	22 [0.87]

2 Servo oil pump HSP-025-110-23A



Component	Model Number	Quantity
Motor	ECMA-ER181BP3	1
Oil pump	EIPC3-025RK23	1
Pressure sensor	WIKA A-10	1

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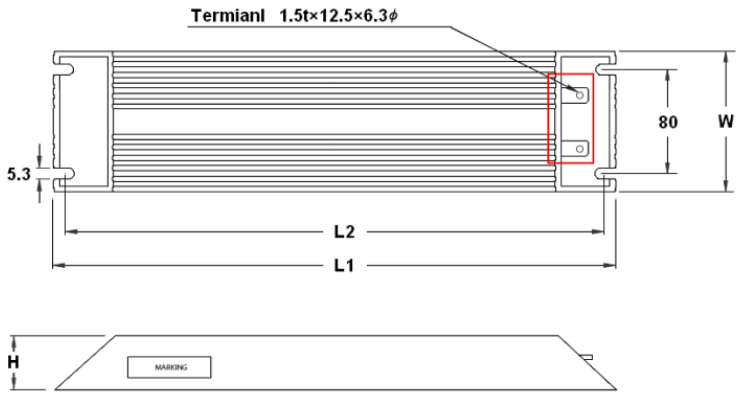
3 Accessories Kit HESP-063-H-N-23

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W8P3	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

※ Braking resistor 1000W 8.3Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

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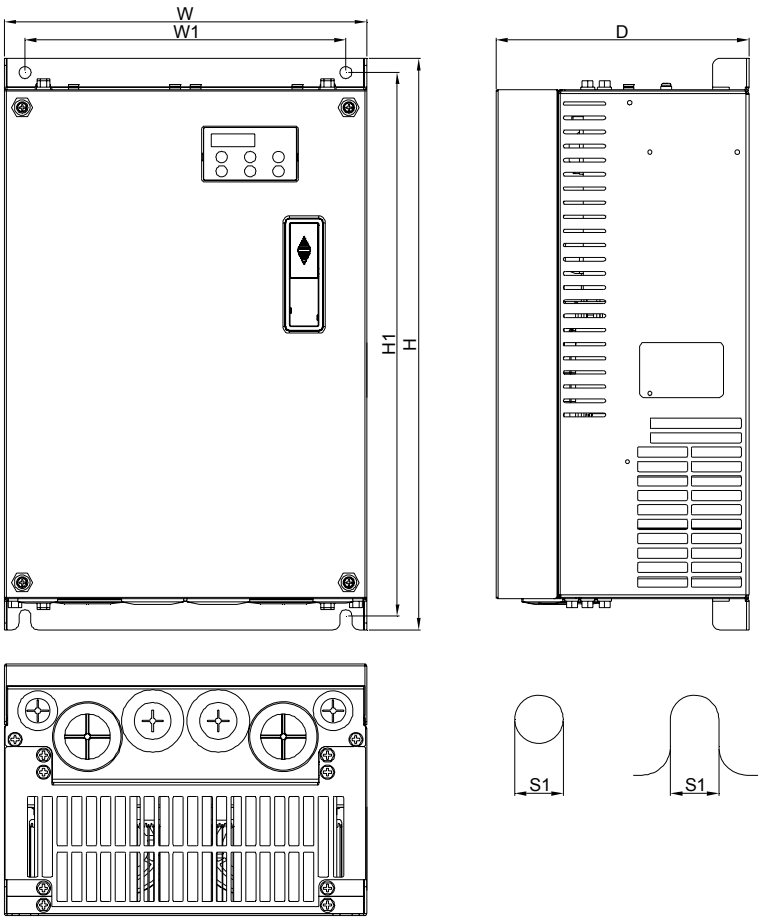
HES080G23A

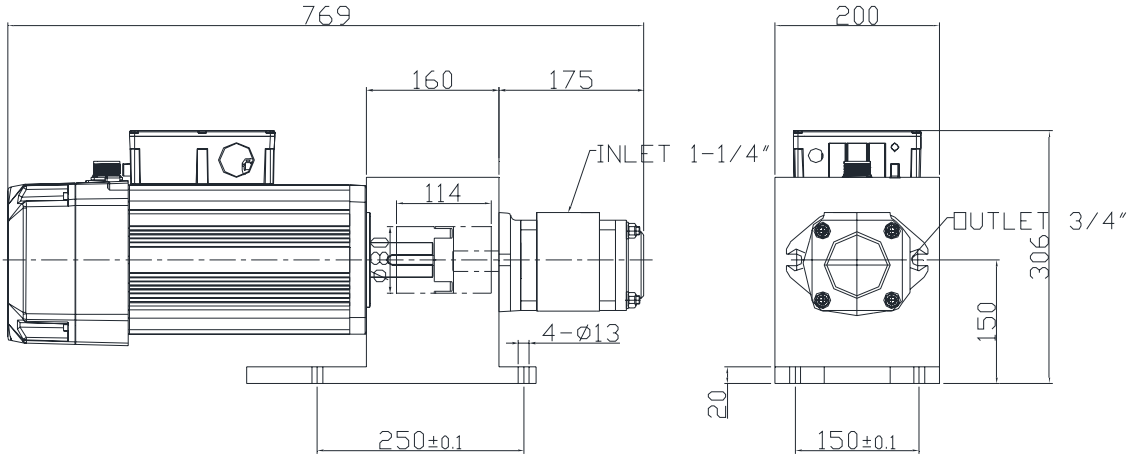
1 Servo controller VFD110VL23A-J



Unit: mm[inch]

W	W1	H	H1	H2	H3	D	Ø	Ø1	Ø2	Ø3
235 [9.25]	204 [8.03]	350 [13.78]	337 [13.27]	320 [12.60]	-	136 [5.35]	6.5 [0.26]	-	34 [1.34]	22 [0.87]

2 Servo oil pump HSP-032-110-23A



Component	Model Number	Quantity
Motor	ECMA-ER181BP3	1
Oil pump	EIPC3-032RK23	1
Pressure sensor	WIKA A-10	1

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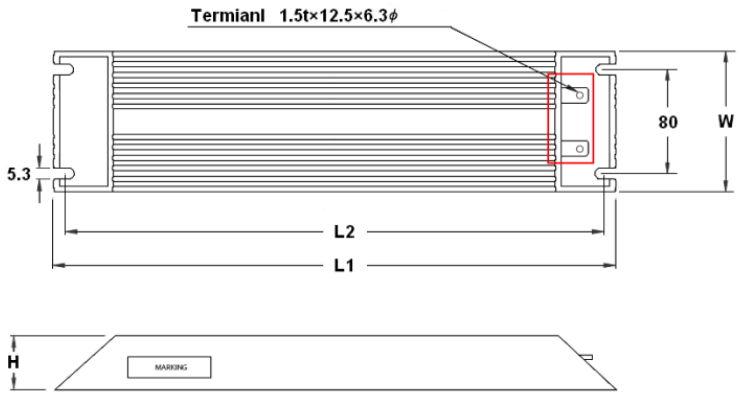
3 Accessories Kit HESP-080-G-N-23

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W8P3	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

※ Braking resistor 1000W 8.3Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

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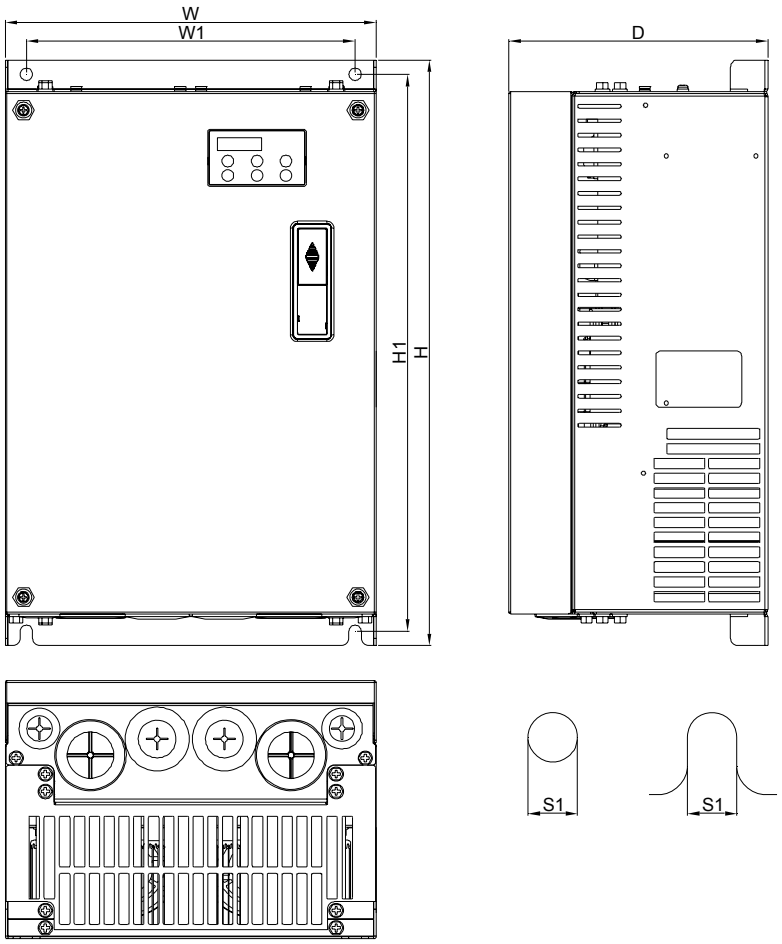
HES080H23A

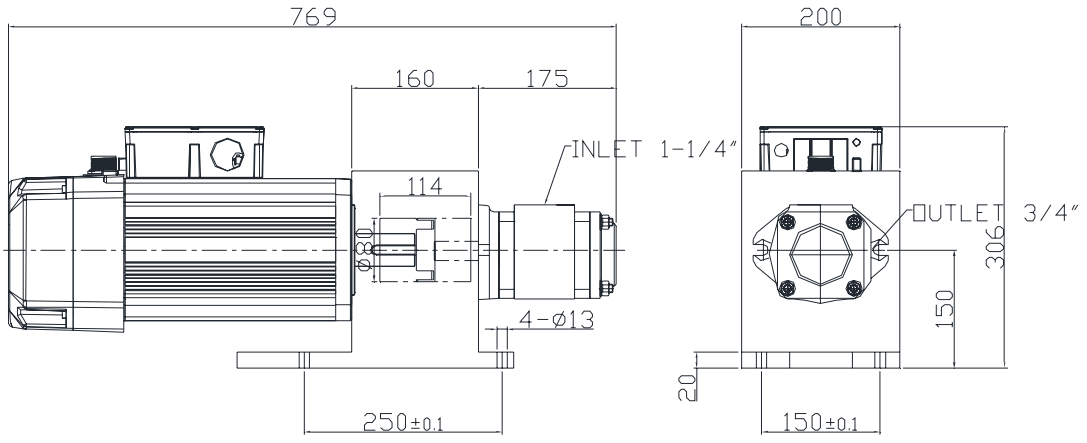
1 Servo controller VFD150VL23A-J



Unit: mm[inch]

W	W1	H	H1	H2	H3	D	Ø	Ø1	Ø2	Ø3
255.0 [10.04]	226.0 [8.90]	403.8 [15.90]	384.0 [15.12]	360.0 [14.17]	21.9 [0.86]	168.0 [6.61]	8.5 [0.33]	44 [1.73]	34 [1.34]	22 [0.87]

2 Servo oil pump HSP-032-110-23A



Component	Model Number	Quantity
Motor	ECMA-ER181BP3	1
Oil pump	EIPC3-032RK23	1
Pressure sensor	WIKA A-10	1

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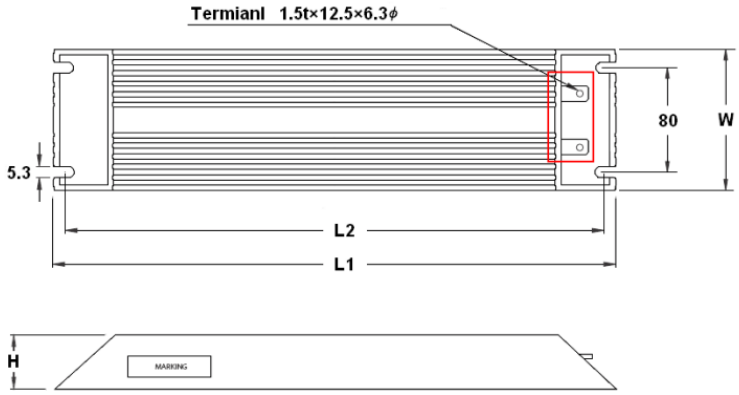
3 Accessories Kit HESP-080-H-N-23

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W5P8	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

※ Braking resistor 1000W 5.8Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

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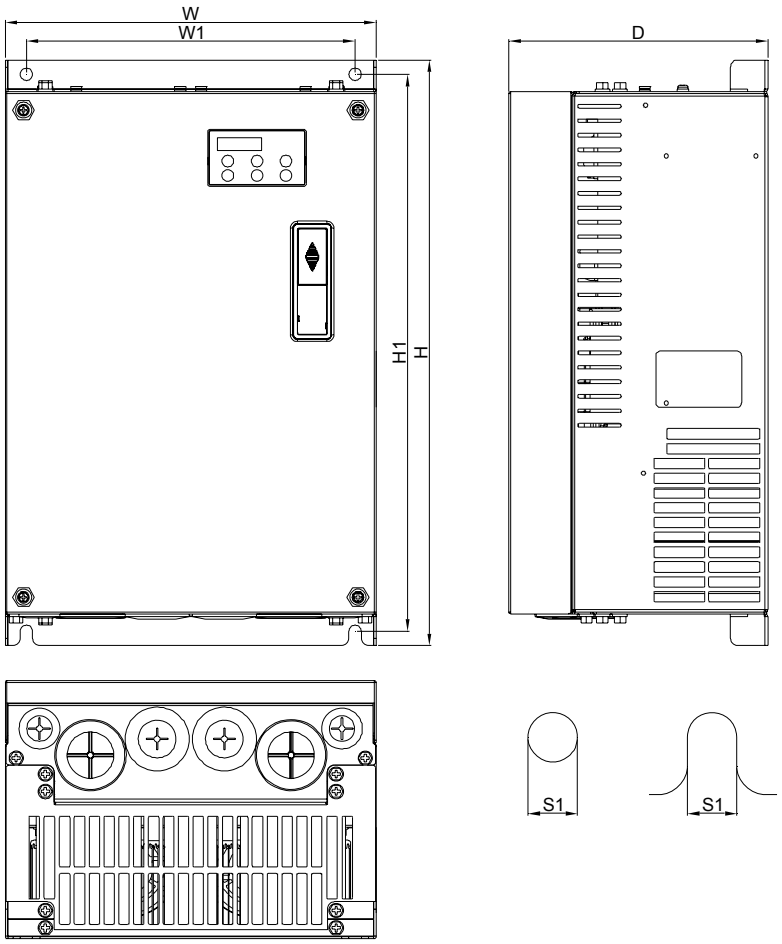
HES100G23A

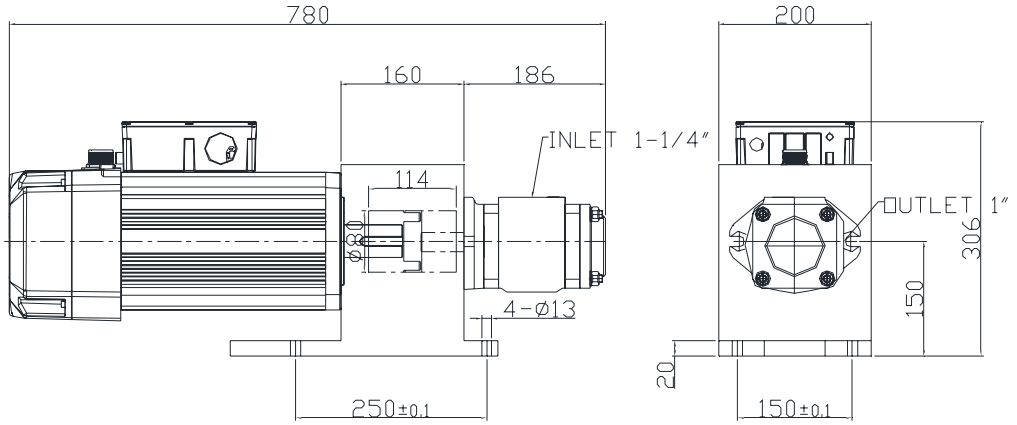
1 Servo controller VFD150VL23A-J



Unit: mm[inch]

W	W1	H	H1	H2	H3	D	Ø	Ø1	Ø2	Ø3
255.0 [10.04]	226.0 [8.90]	403.8 [15.90]	384.0 [15.12]	360.0 [14.17]	21.9 [0.86]	168.0 [6.61]	8.5 [0.33]	44 [1.73]	34 [1.34]	22 [0.87]

2 Servo oil pump HSP-040-110-23A



Component	Model Number	Quantity
Motor	ECMA-ER181BP3	1
Oil pump	EIPC3-040RK23	1
Pressure sensor	WIKA A-10	1

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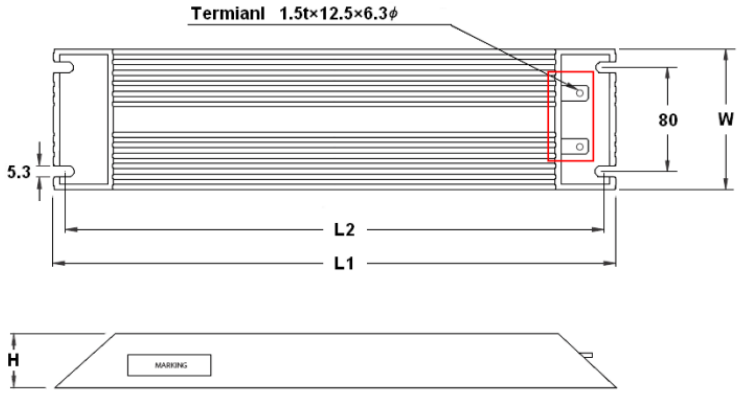
3 Accessories Kit HESP-100-G-N-23

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W5P8	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

※ Braking resistor 1000W 5.8Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

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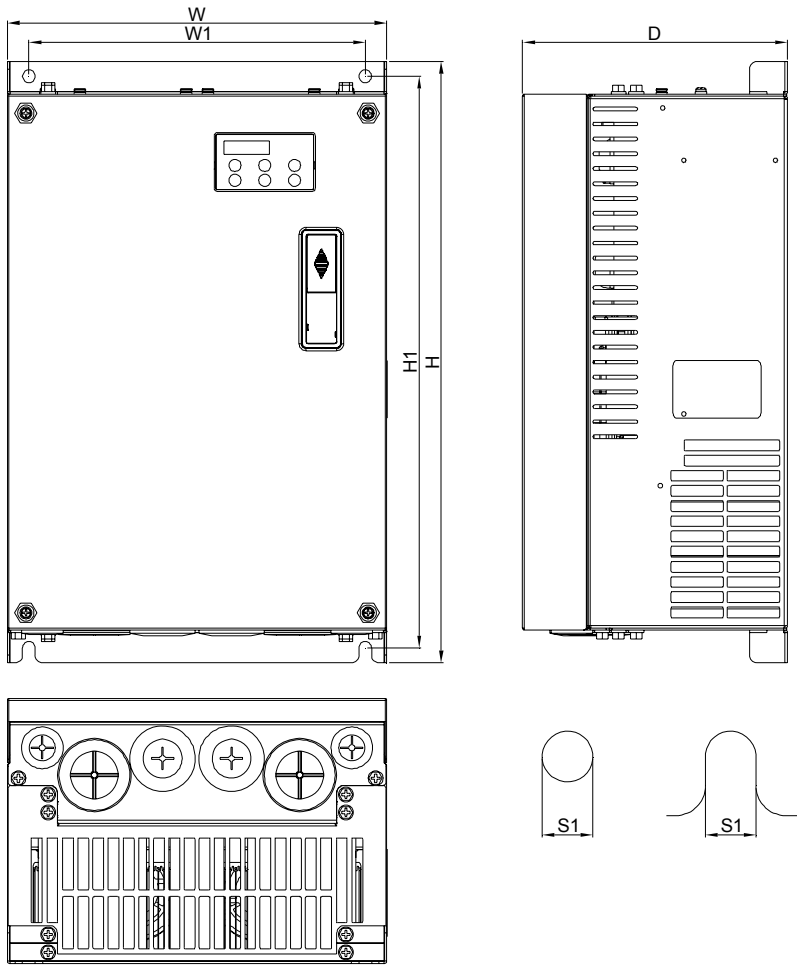
HES100H23A

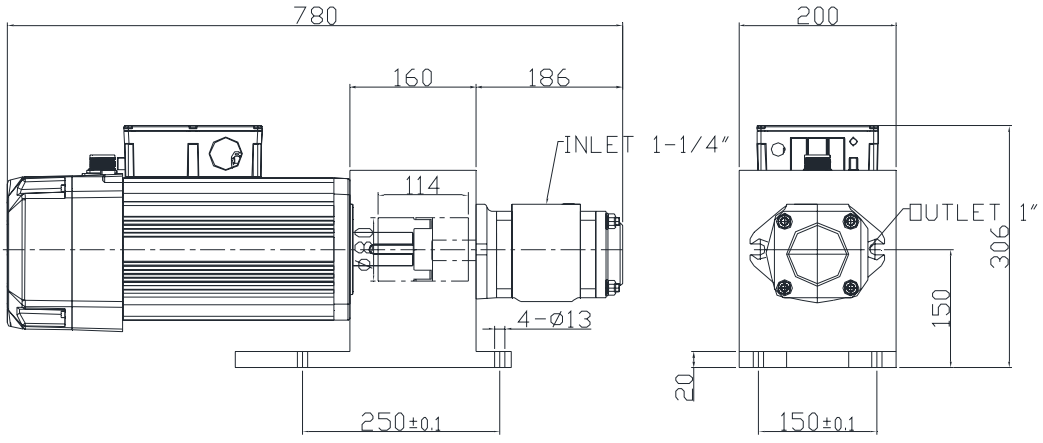
1 Servo controller VFD185VL23A-J



Unit: mm[inch]

W	W1	H	H1	H2	H3	D	Ø	Ø1	Ø2	Ø3
255.0 [10.04]	226.0 [8.90]	403.8 [15.90]	384.0 [15.12]	360.0 [14.17]	21.9 [0.86]	168.0 [6.61]	8.5 [0.33]	44 [1.73]	34 [1.34]	22 [0.87]

2 Servo oil pump HSP-040-110-23A



Component	Model Number	Quantity
Motor	ECMA-ER181BP3	1
Oil pump	EIPC3-040RK23	1
Pressure sensor	WIKA A-10	1

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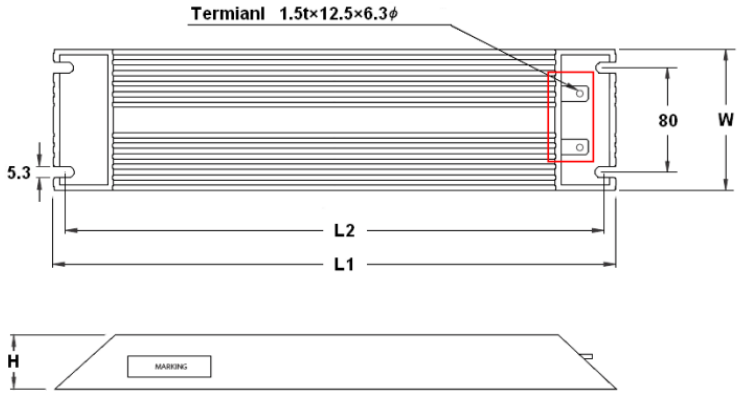
3 Accessories Kit HESP-100-H-N-23

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W5P8	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

※ Braking resistor 1000W 5.8Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

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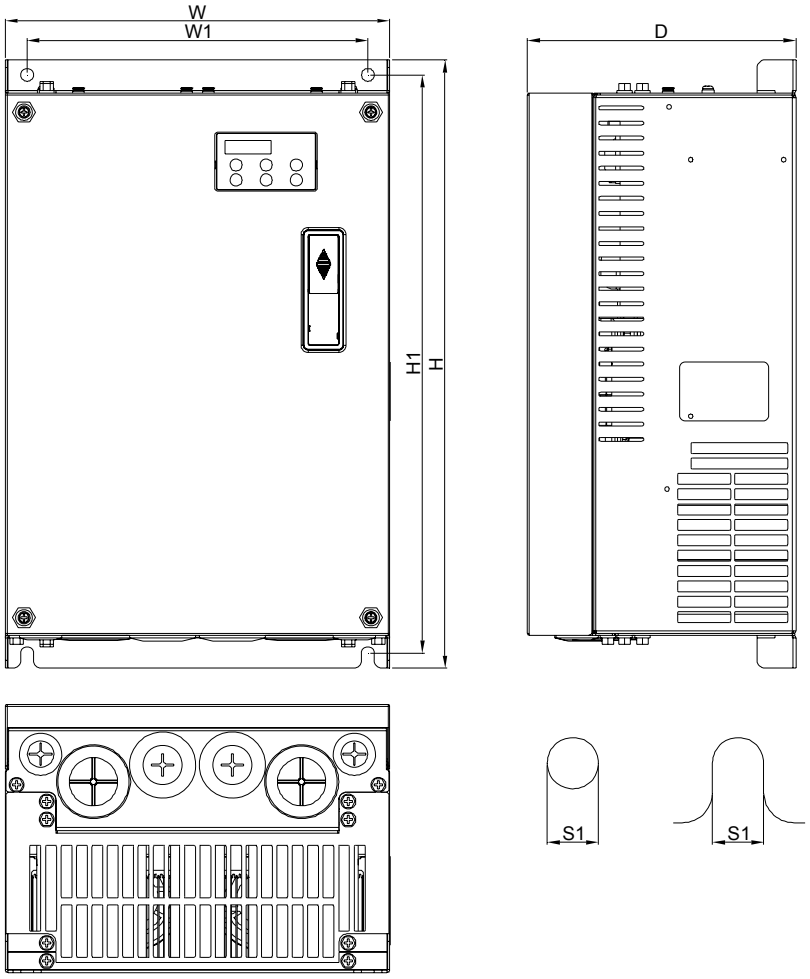
HES125G23A

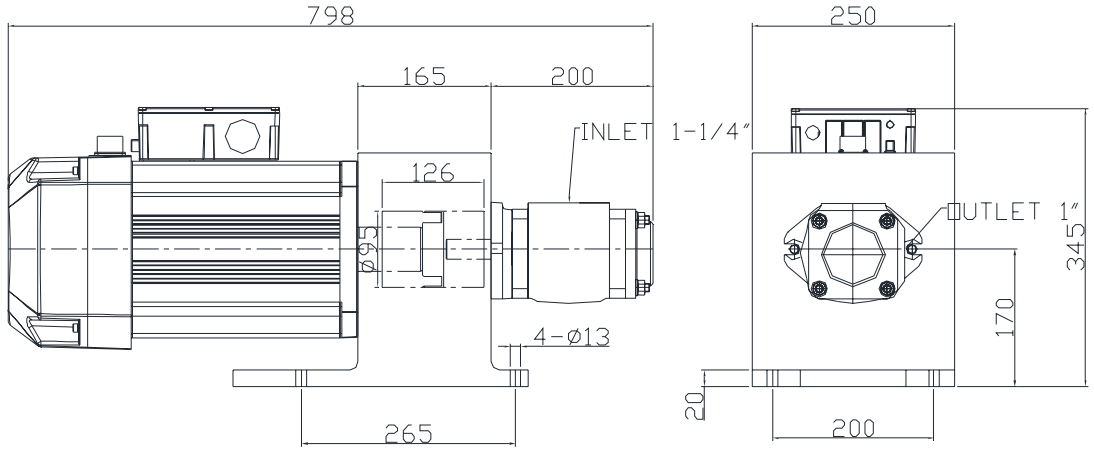
1 Servo controller VFD220VL23A-J



Unit: mm[inch]

W	W1	H	H1	H2	H3	D	Ø	Ø1	Ø2	Ø3
255.0 [10.04]	226.0 [8.90]	403.8 [15.90]	384.0 [15.12]	360.0 [14.17]	21.9 [0.86]	168.0 [6.61]	8.5 [0.33]	44 [1.73]	34 [1.34]	22 [0.87]

2 Servo oil pump HSP-050-150-23A



Component	Model Number	Quantity
Motor	ECMA-ER221FPS	1
Oil pump	EIPC3-050RK23	1
Pressure sensor	WIKA A-10	1

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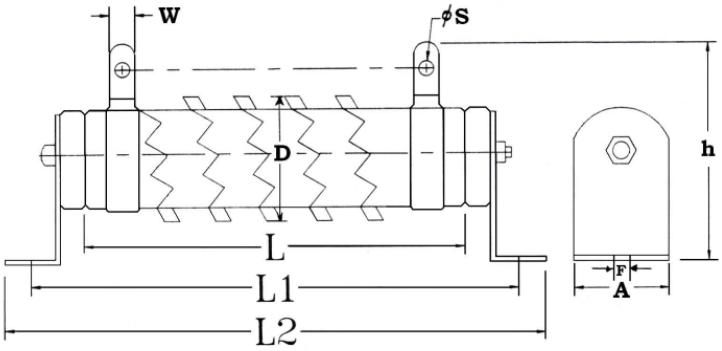
3 Accessories Kit HESP-125-G-N-23

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR2250W5P8	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

※ Braking resistor 2250W 5.8Ω Unit: min



L ± 5	L1 ± 10	L2 ± 10	D ± 5	W ± 0.2	S ± 0.1	A ± 1	F ± 0.1	h ± 10
500	584	610	72	15	8.1	65	9.1	130

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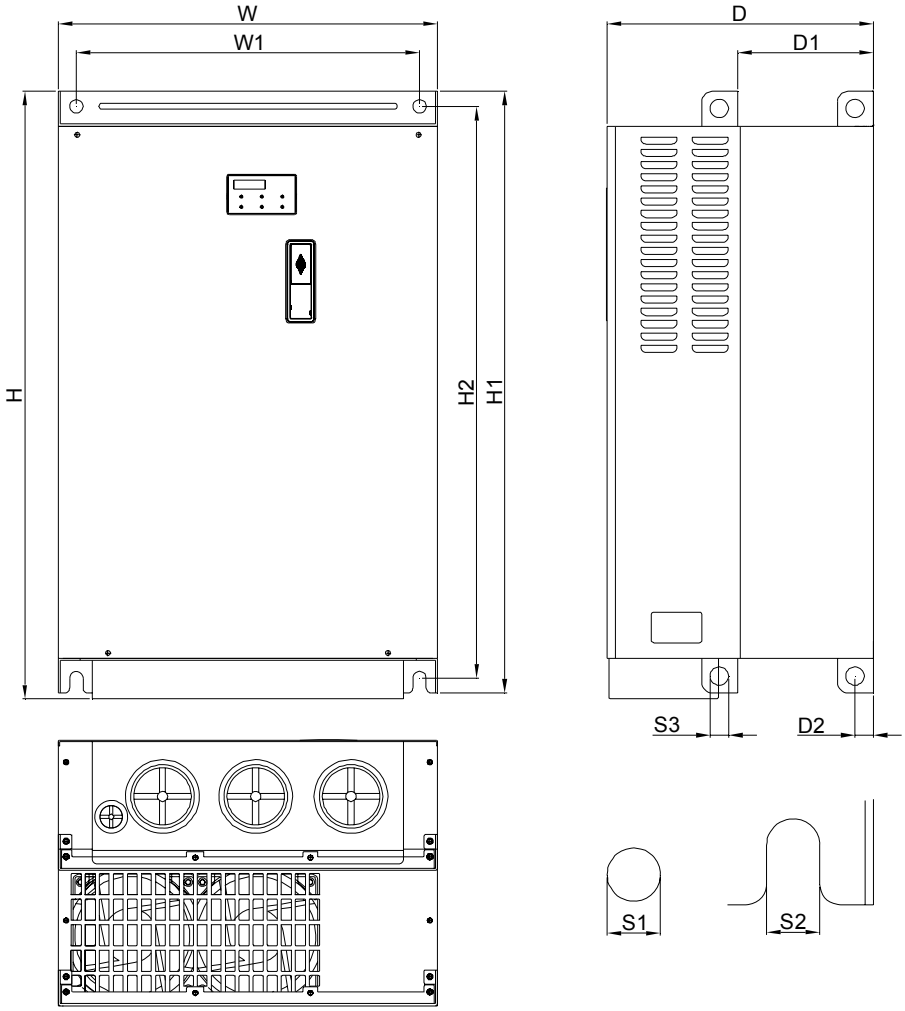
HES125H23A

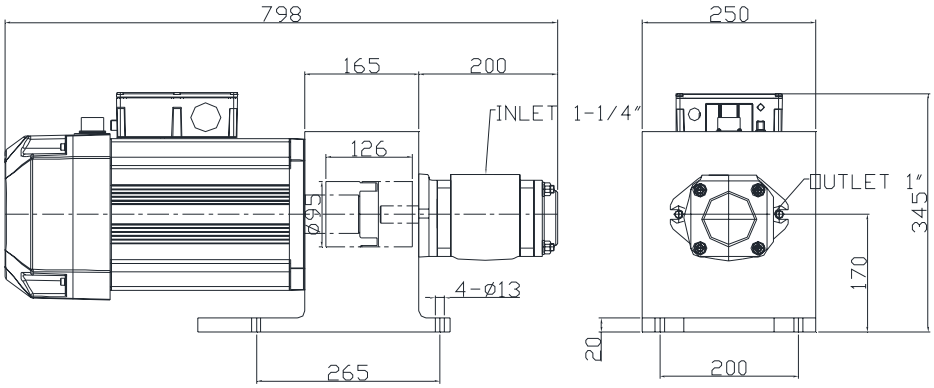
1 Servo controller VFD300VL23A-J



Unit: mm[inch]

W	W1	H	H1	H2	D	D1	D2	S1	S2	S3
370.0 [14.57]	335.0 [13.19]	595.0 [23.43]	589.0 [23.19]	560.0 [22.05]	260.0 [10.24]	132.5 [5.22]	18.0 [0.71]	13.0 [0.51]	13.0 [0.51]	18.0 [0.71]

2 Servo oil pump HSP-050-150-23A



Component	Model Number	Quantity
Motor	ECMA-ER221FPS	1
Oil pump	EIPC3-050RK23	1
Pressure sensor	WIKA A-10	1

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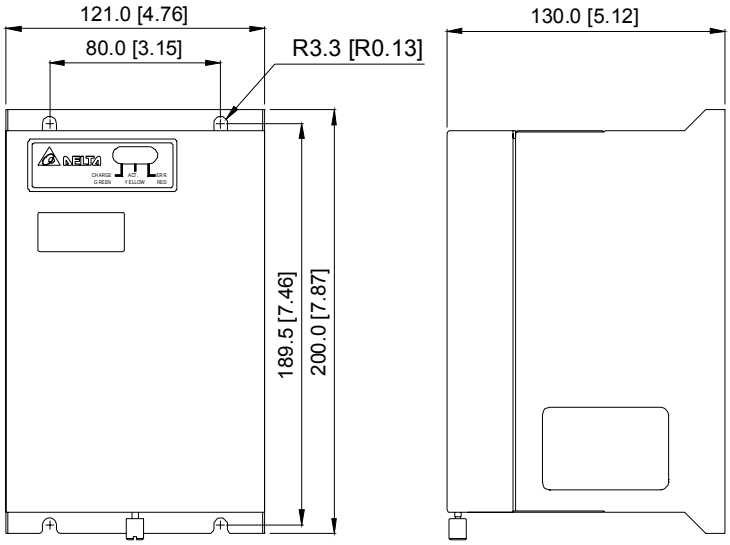
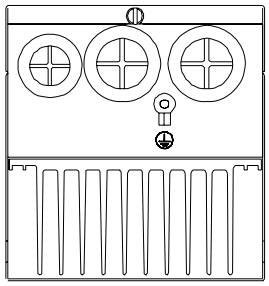
3 Accessories Kit HESP-125-H-B-23

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※1 Braking unit	VFDB-2022	1
※2 Braking resistor	BR2250W6P8	1

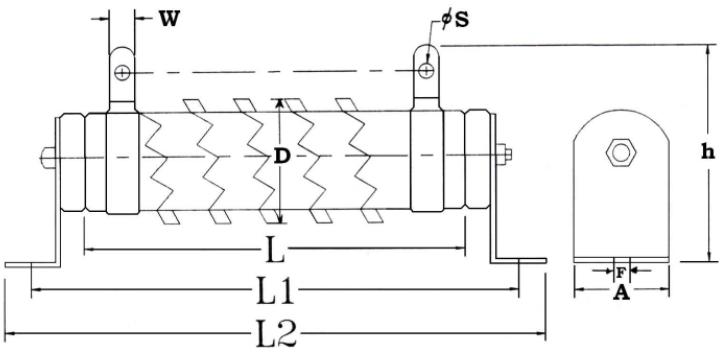
Coding device cable 5m*1	Magnetic ring of power cable*3	Sensor clamp*1

※1 Braking unit VFDB-2022





※2 Braking resistor 2250W 6.8Ω Unit: min



L ± 5	L1 ± 10	L2 ± 10	D ± 5	W ± 0.2	S ± 0.1	A ± 1	F ± 0.1	h ± 10
500	584	610	72	15	8.1	65	9.1	130

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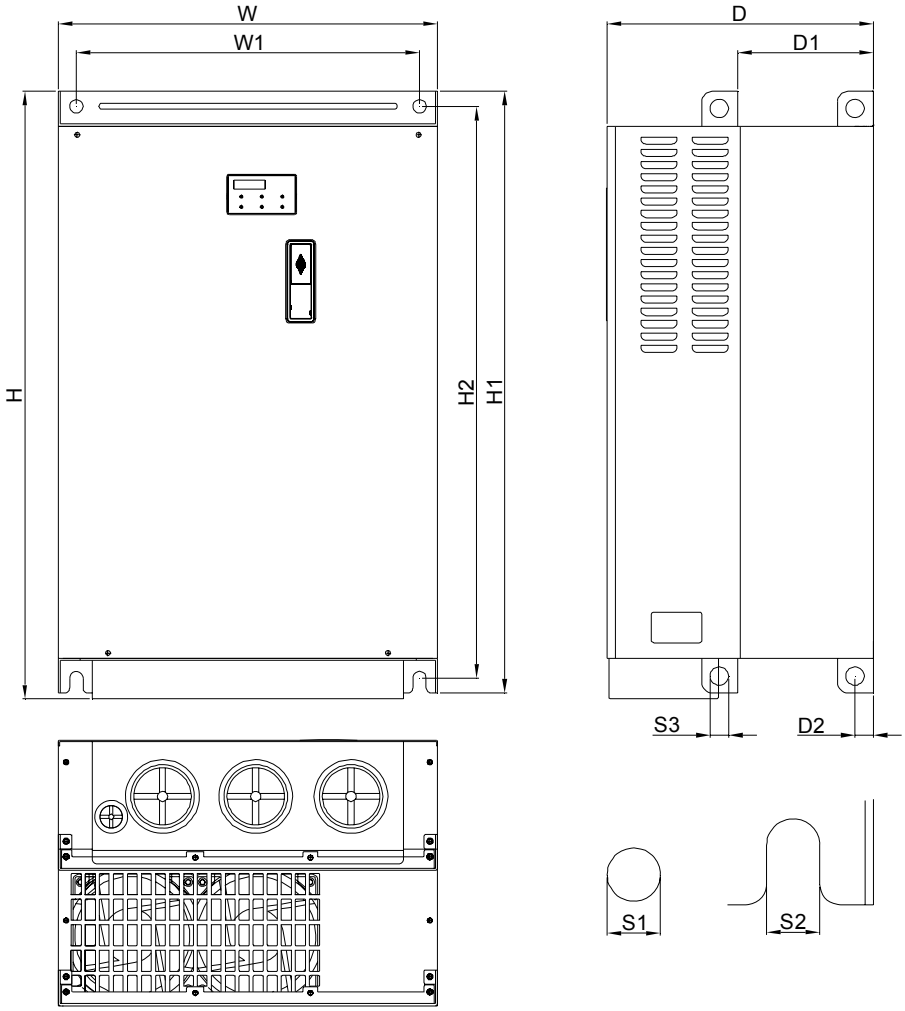
HES160G23A

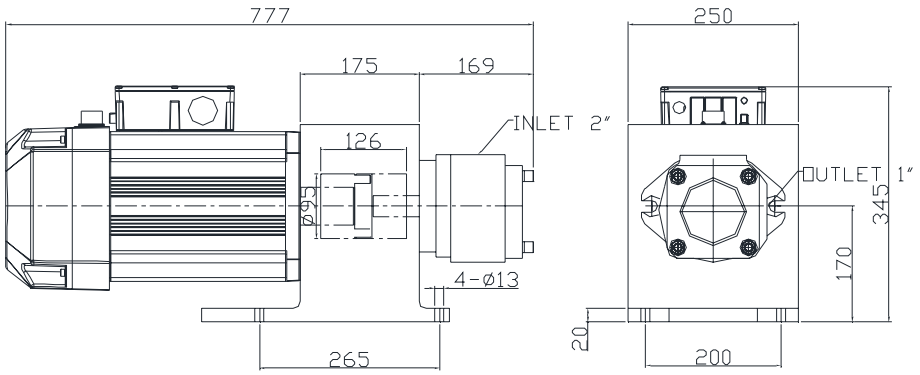
1 Servo controller VFD300VL23A-J



Unit: mm[inch]

W	W1	H	H1	H2	D	D1	D2	S1	S2	S3
370.0 [14.57]	335.0 [13.19]	595.0 [23.43]	589.0 [23.19]	560.0 [22.05]	260.0 [10.24]	132.5 [5.22]	18.0 [0.71]	13.0 [0.51]	13.0 [0.51]	18.0 [0.71]

2 Servo oil pump HSP-064-150-23A



Component	Model Number	Quantity
Motor	ECMA-ER221FPS	1
Oil pump	EIPC3-064RK23	1
Pressure sensor	WIKA A-10	1

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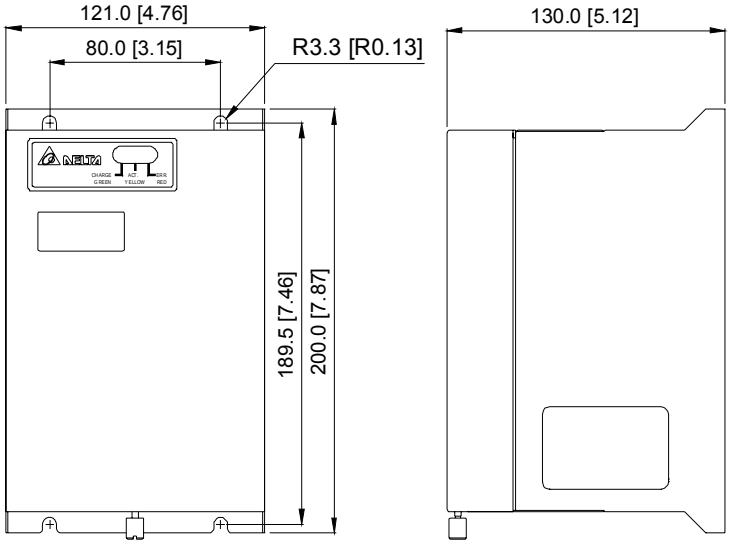
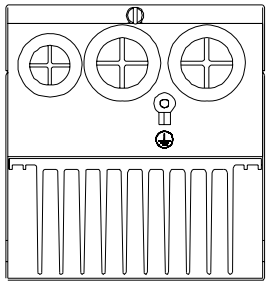
3 Accessories Kit HESP-160-G-B-23

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※1 Braking unit	VFDB-2022	1
※2 Braking resistor	BR2250W6P8	1

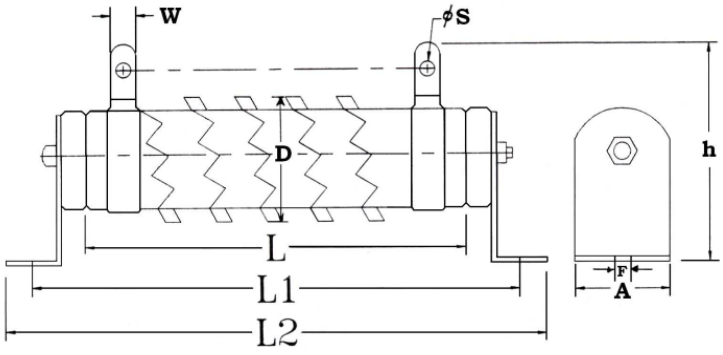
Coding device cable 5m*1	Magnetic ring of power cable*3	Sensor clamp*1

※1 Braking unit VFDB-2022





※2 Braking resistor 2250W 6.8Ω Unit: min



L ± 5	L1 ± 10	L2 ± 10	D ± 5	W ± 0.2	S ± 0.1	A ± 1	F ± 0.1	h ± 10
500	584	610	72	15	8.1	65	9.1	130

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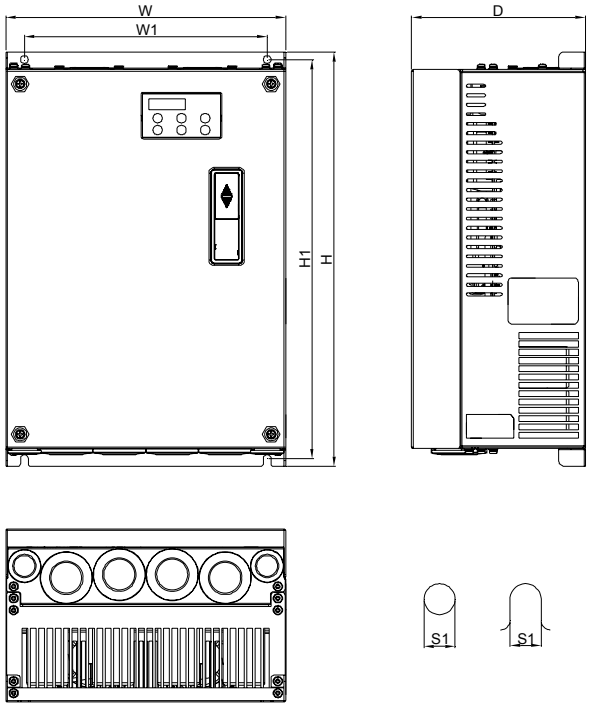
HES063G43A

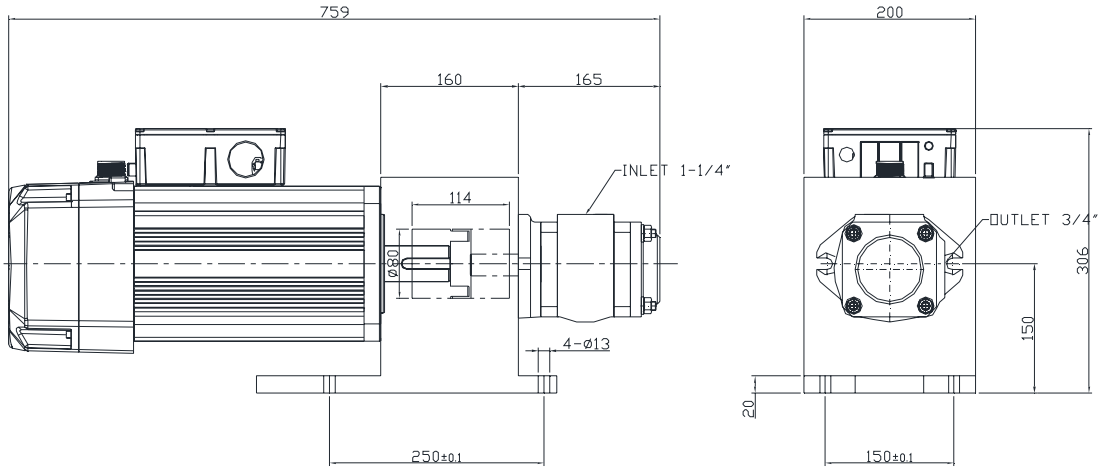
1 Servo controller VFD110VL43A-J



Unit: mm[inch]

W	W1	H	H1	H2	H3	D	Ø	Ø1	Ø2	Ø3
235 [9.25]	204 [8.03]	350 [13.78]	337 [13.27]	320 [12.60]	-	136 [5.35]	6.5 [0.26]	-	34 [1.34]	22 [0.87]

2 Servo oil pump HSP-025-110-43A



Component	Model Number	Quantity
Motor	ECMA-ER181BP3	1
Oil pump	EIPC3-025RK23	1
Pressure sensor	WIKA A-10	1

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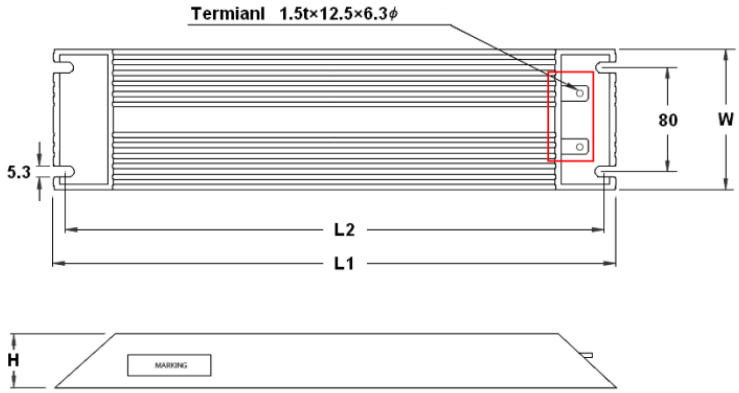
3 Accessories Kit HESP-063-G-N-43

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W025	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

※ Braking resistor 1000W 25Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

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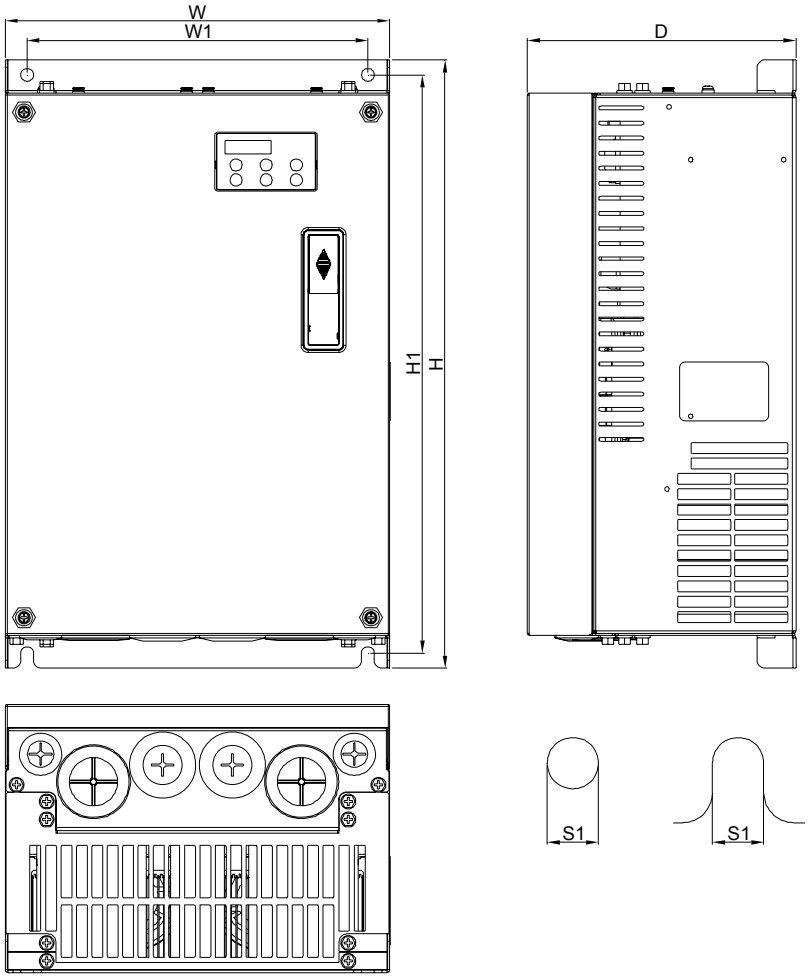
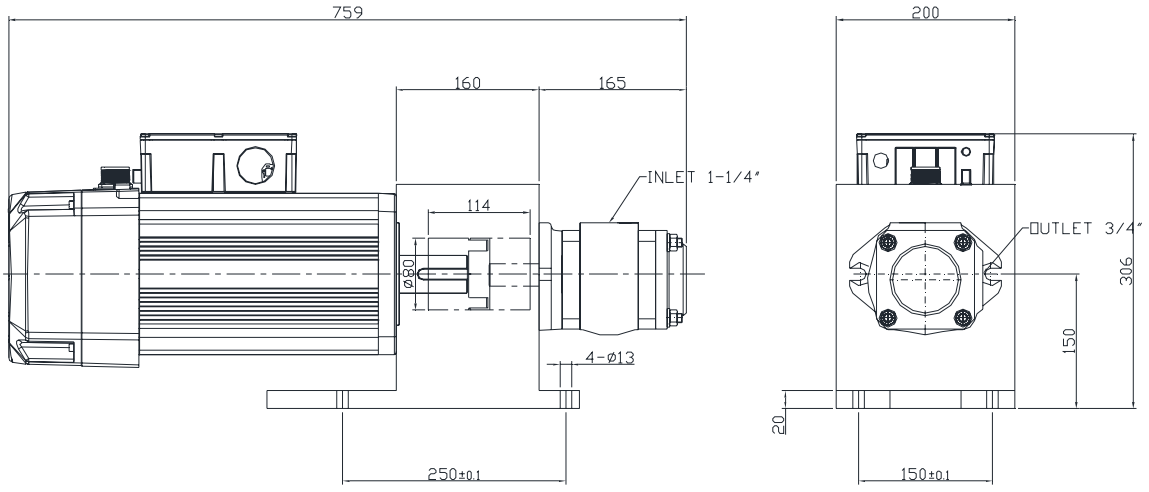
1 Servo controller VFD150VL43A-J



Unit: mm[inch]

W	W1	H	H1	H2	H3	D	Ø	Ø1	Ø2	Ø3
255.0 [10.04]	226.0 [8.90]	403.8 [15.90]	384.0 [15.12]	360.0 [14.17]	21.9 [0.86]	168.0 [6.61]	8.5 [0.33]	44 [1.73]	34 [1.34]	22 [0.87]

2 Servo oil pump HSP-025-110-43A



Component	Model Number	Quantity
Motor	ECMA-ER181BP3	1
Oil pump	EIPC3-025RK23	1
Pressure sensor	WIKA A-10	1

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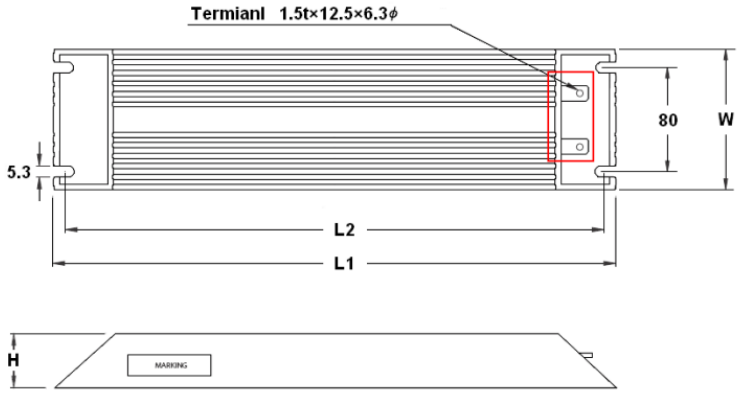
3 Accessories Kit HESP-063-H-N-43

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W025	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

※ Braking resistor 1000W 25Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

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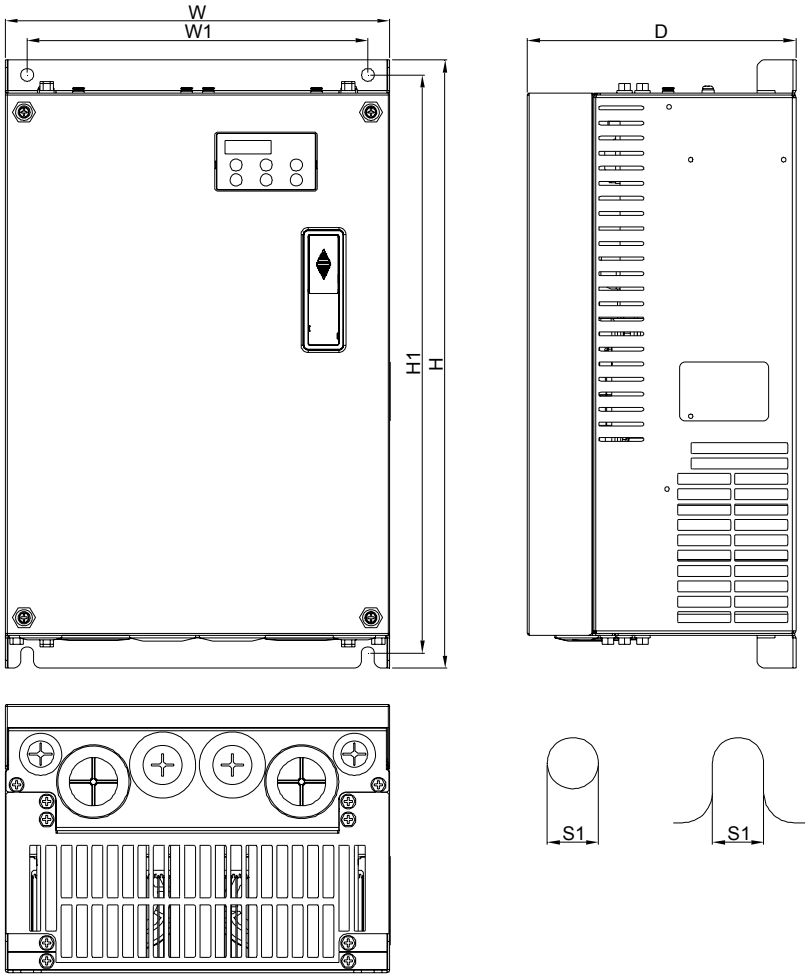
HES080G43A

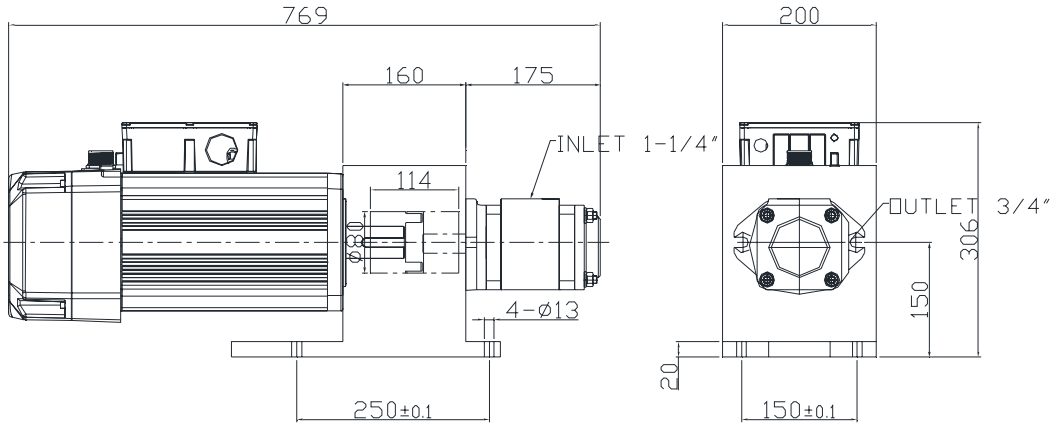
1 Servo controller VFD150VL43A-J



Unit: mm[inch]

W	W1	H	H1	H2	H3	D	Ø	Ø1	Ø2	Ø3
255.0 [10.04]	226.0 [8.90]	403.8 [15.90]	384.0 [15.12]	360.0 [14.17]	21.9 [0.86]	168.0 [6.61]	8.5 [0.33]	44 [1.73]	34 [1.34]	22 [0.87]

2 Servo oil pump HSP-032-110-43A



Component	Model Number	Quantity
Motor	ECMA-ER181BP3	1
Oil pump	EIPC3-032RK23	1
Pressure sensor	WIKA A-10	1

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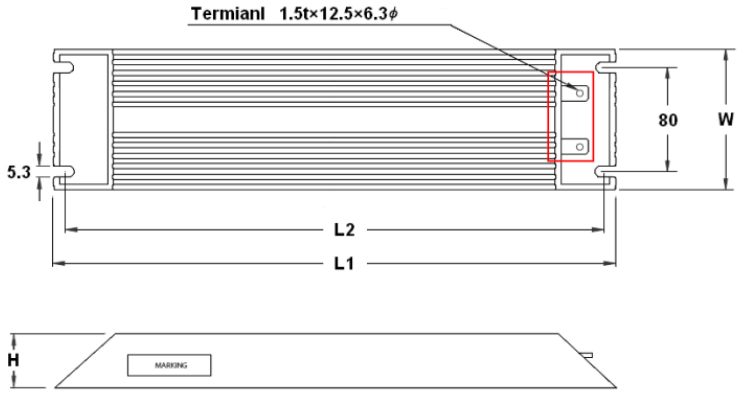
3 Accessories Kit HESP-080-G-N-43

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W025	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

※ Braking resistor 1000W 25Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

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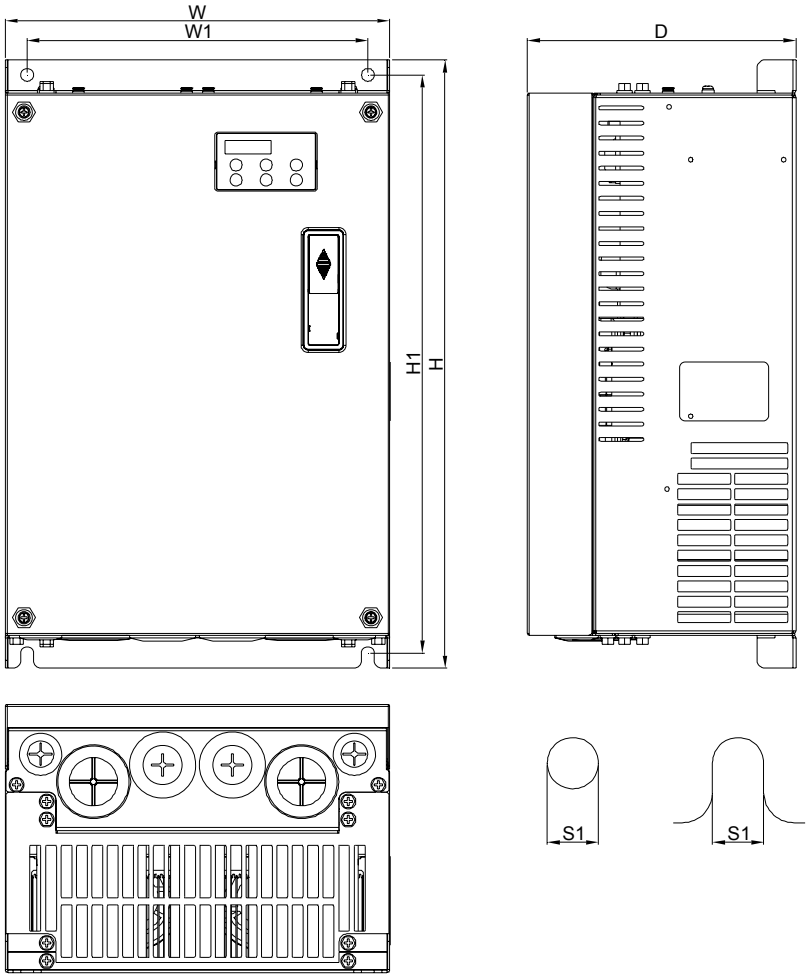
HES080H43A

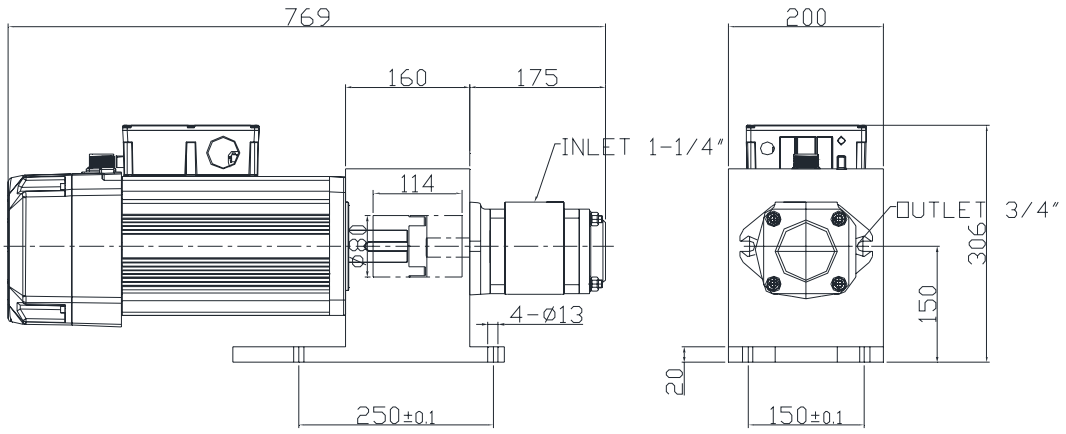
1 Servo controller VFD185VL43A-J



Unit: mm[inch]

W	W1	H	H1	H2	H3	D	Ø	Ø1	Ø2	Ø3
255.0 [10.04]	226.0 [8.90]	403.8 [15.90]	384.0 [15.12]	360.0 [14.17]	21.9 [0.86]	168.0 [6.61]	8.5 [0.33]	44 [1.73]	34 [1.34]	22 [0.87]

2 Servo oil pump HSP-032-110-43A



Component	Model Number	Quantity
Motor	ECMA-ER181BP3	1
Oil pump	EIPC3-032RK23	1
Pressure sensor	WIKA A-10	1

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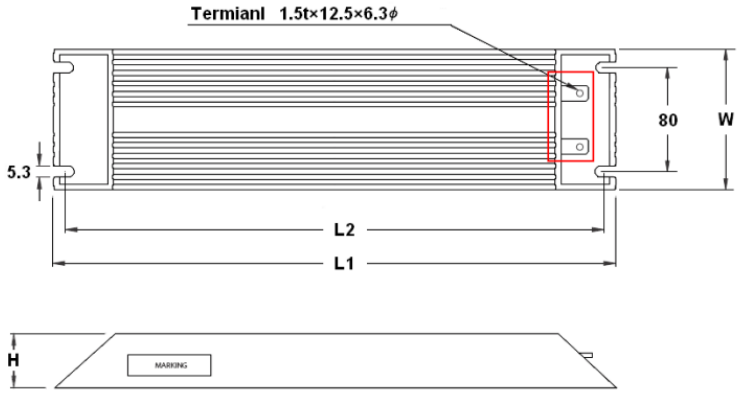
3 Accessories Kit HESP-080-H-N-43

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W025	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

※ Braking resistor 1000W 25Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

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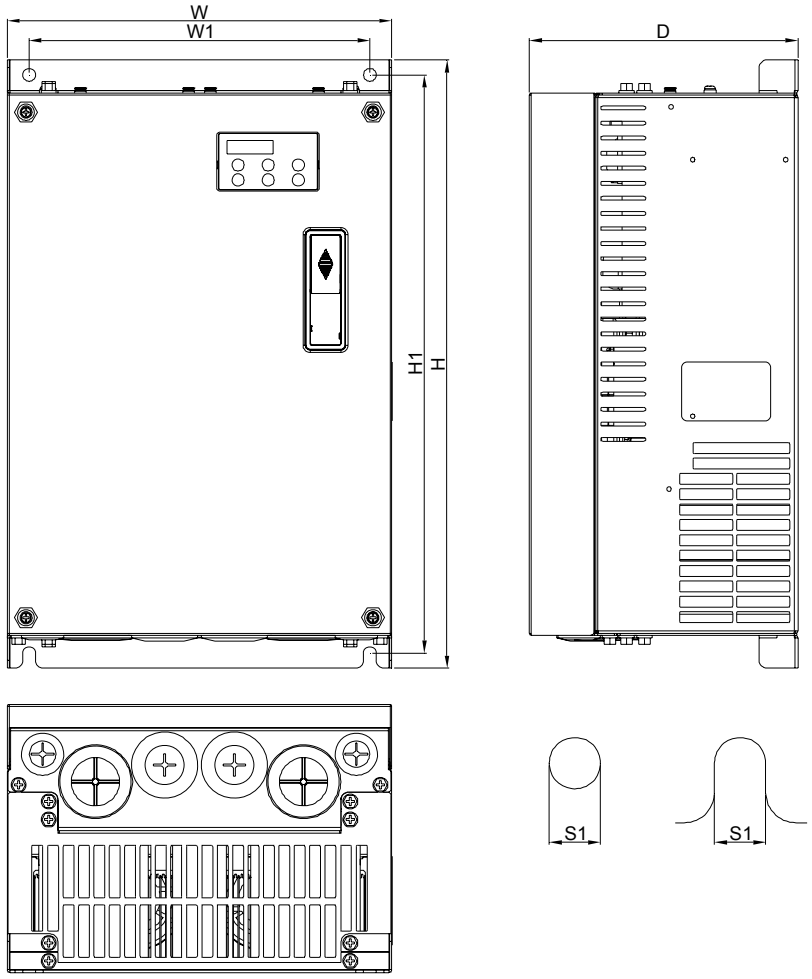
HES100G43A

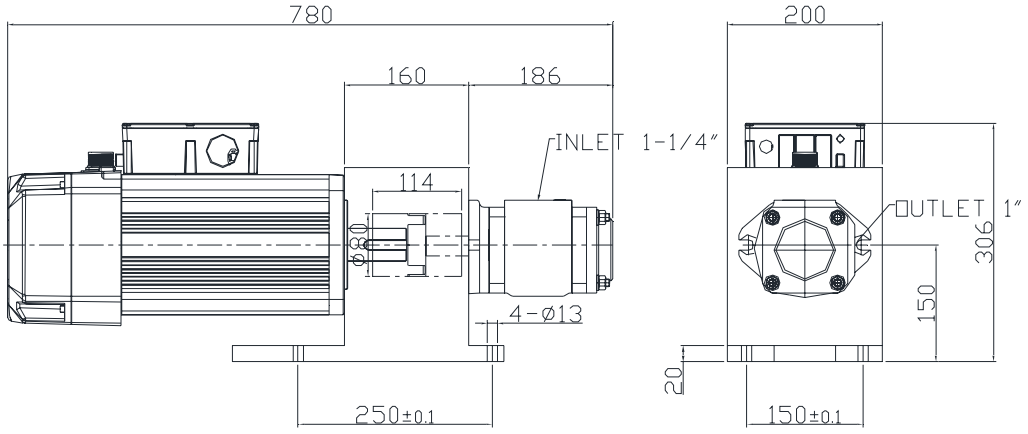
1 Servo controller VFD185VL43A-J



Unit: mm[inch]

W	W1	H	H1	H2	H3	D	Ø	Ø1	Ø2	Ø3
255.0 [10.04]	226.0 [8.90]	403.8 [15.90]	384.0 [15.12]	360.0 [14.17]	21.9 [0.86]	168.0 [6.61]	8.5 [0.33]	44 [1.73]	34 [1.34]	22 [0.87]

2 Servo oil pump HSP-040-110-43A



Component	Model Number	Quantity
Motor	ECMA-ER181BP3	1
Oil pump	EIPC3-040RK23	1
Pressure sensor	WIKA A-10	1

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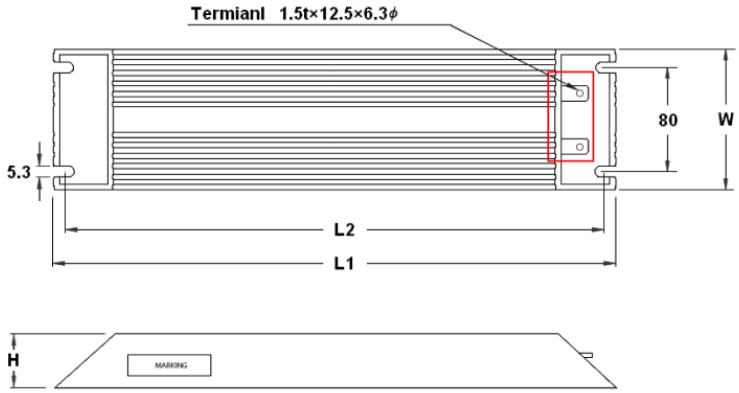
3 Accessories Kit HESP-100-G-N-43

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W025	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

※ Braking resistor 1000W 25Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

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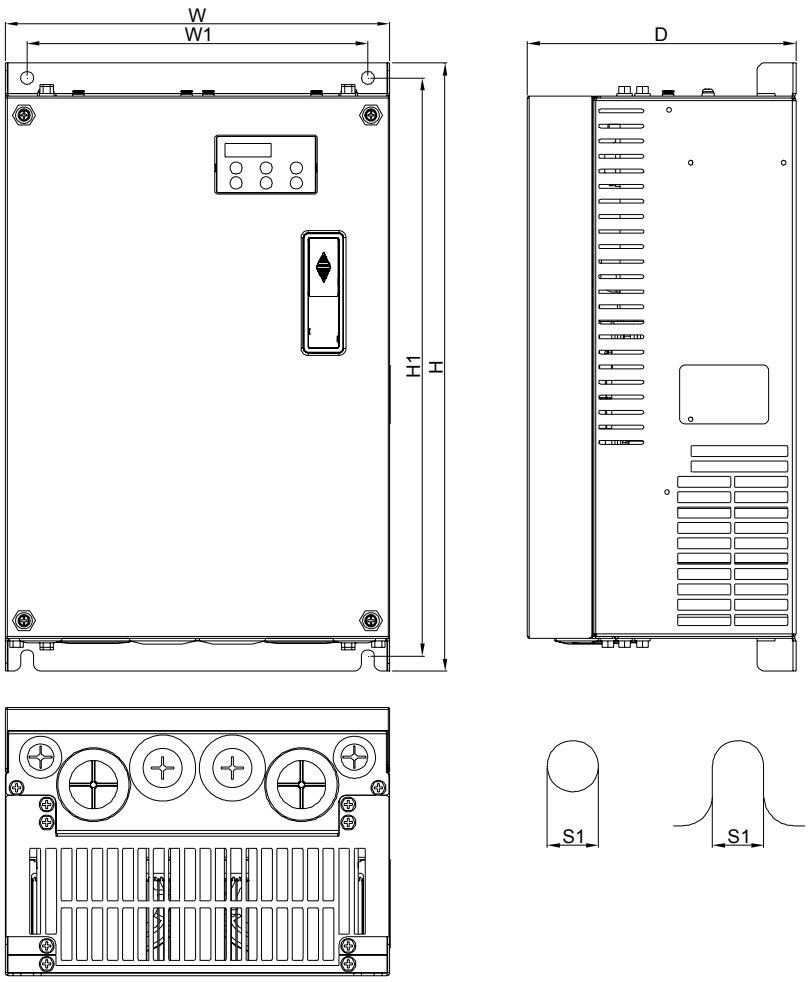
HES100H43A

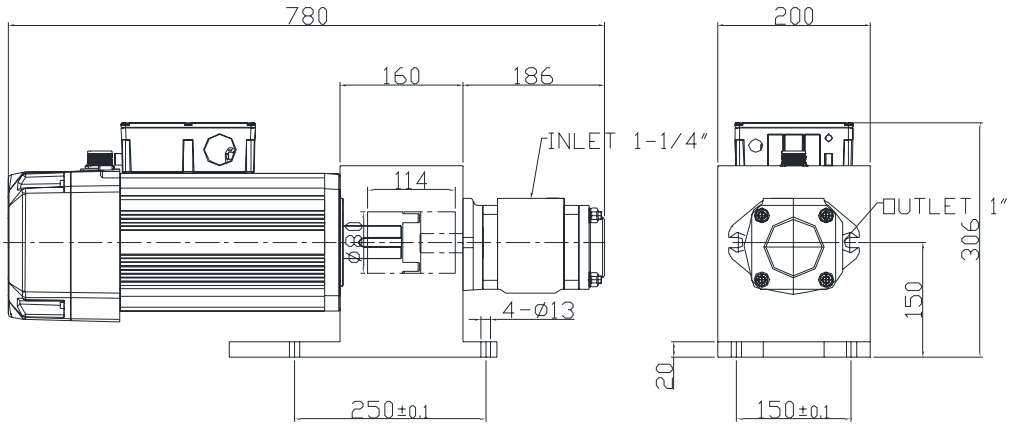
1 Servo controller VFD220VL43A-J



Unit: mm[inch]

W	W1	H	H1	H2	H3	D	Ø	Ø1	Ø2	Ø3
255.0 [10.04]	226.0 [8.90]	403.8 [15.90]	384.0 [15.12]	360.0 [14.17]	21.9 [0.86]	168.0 [6.61]	8.5 [0.33]	44 [1.73]	34 [1.34]	22 [0.87]

2 Servo oil pump HSP-040-110-43A



Component	Model Number	Quantity
Motor	ECMA-ER181BP3	1
Oil pump	EIPC3-040RK23	1
Pressure sensor	WIKA A-10	1

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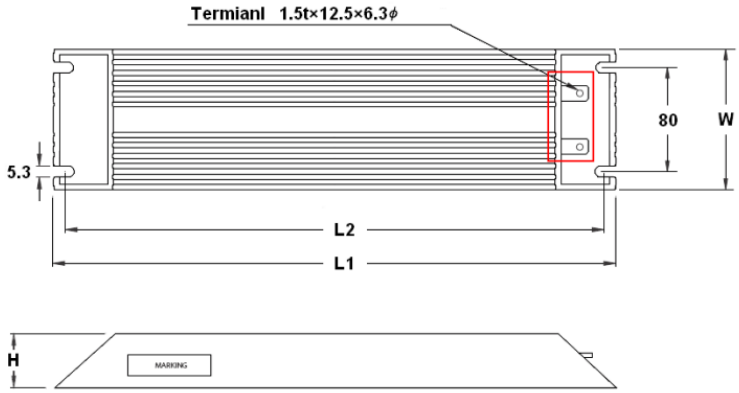
3 Accessories Kit HESP-100-H-N-43

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W025	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

※ Braking resistor 1000W 25Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

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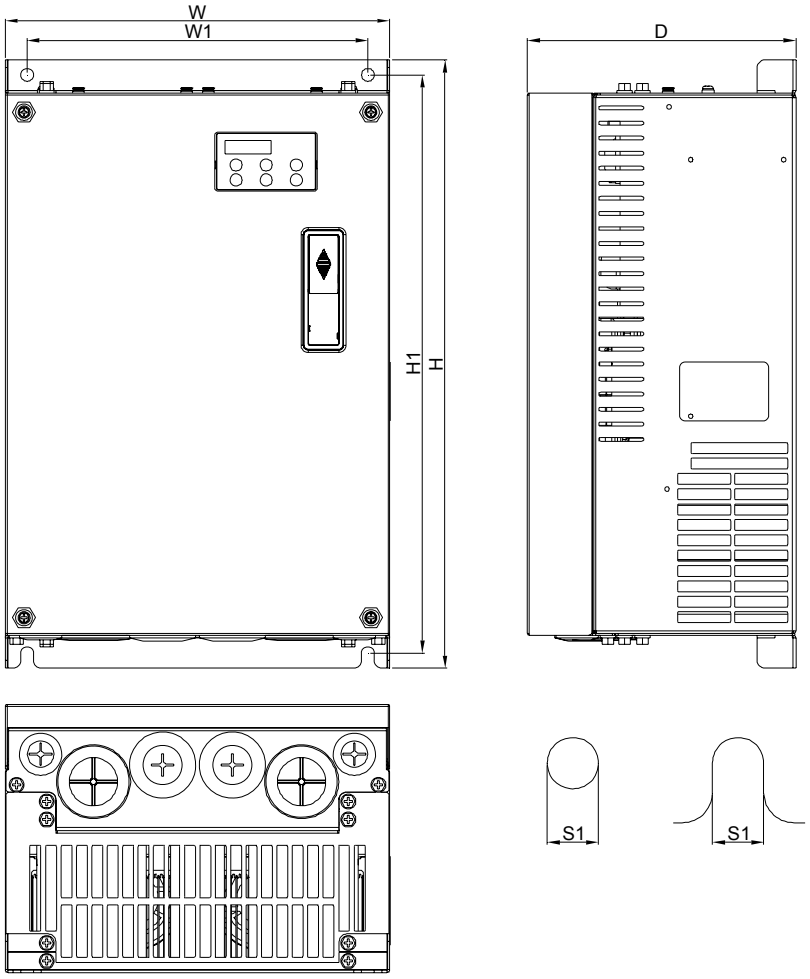
HES125G43A

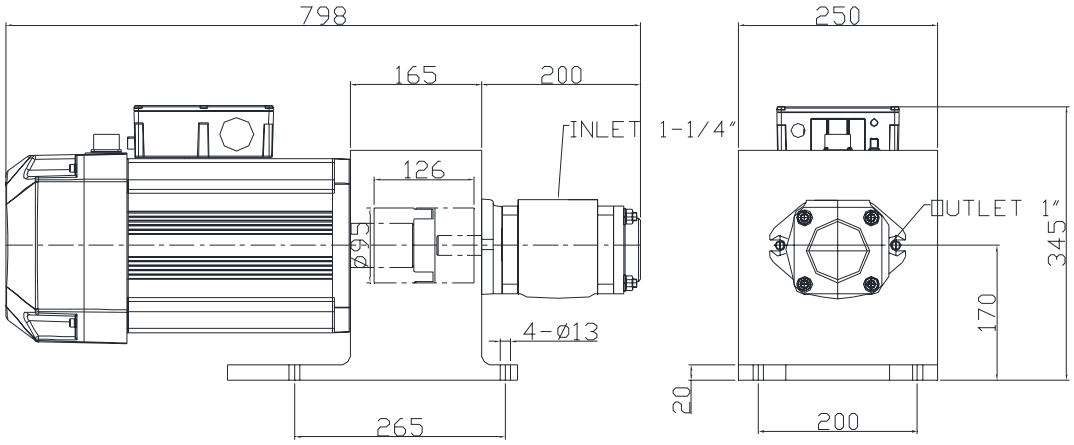
1 Servo controller VFD220VL43A-J



Unit: mm[inch]

W	W1	H	H1	H2	H3	D	Ø	Ø1	Ø2	Ø3
255.0 [10.04]	226.0 [8.90]	403.8 [15.90]	384.0 [15.12]	360.0 [14.17]	21.9 [0.86]	168.0 [6.61]	8.5 [0.33]	44 [1.73]	34 [1.34]	22 [0.87]

2 Servo oil pump HSP-050-150-43A



Component	Model Number	Quantity
Motor	ECMA-KR221FPS	1
Oil pump	EIPC3-050RK23	1
Pressure sensor	WIKA A-10	1

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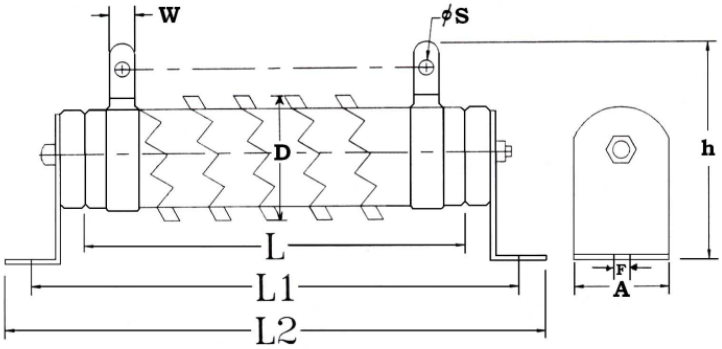
3 Accessories Kit HESP-125-G-N-43

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR2250W020	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

※ Braking resistor 2250W 20Ω Unit: min



L ± 5	L1 ± 10	L2 ± 10	D ± 5	W ± 0.2	S ± 0.1	A ± 1	F ± 0.1	h ± 10
500	584	610	72	15	8.1	65	9.1	130

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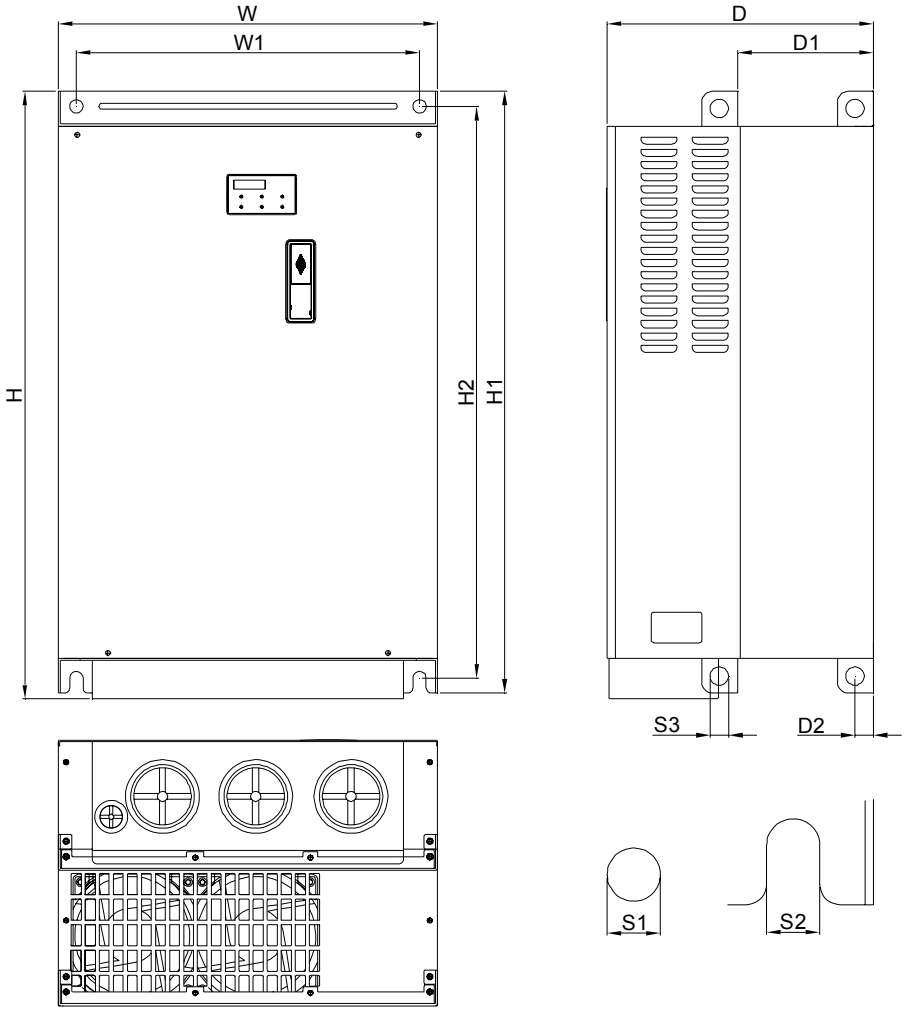
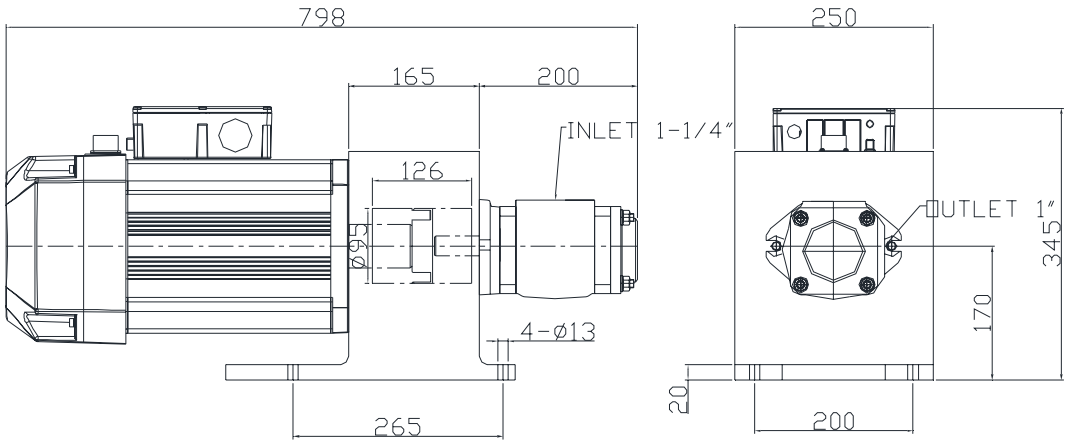
1 Servo controller VFD300VL43A-J



Unit: mm[inch]

W	W1	H	H1	H2	D	D1	D2	S1	S2	S3
370.0 [14.57]	335.0 [13.19]	-	589.0 [23.19]	560.0 [22.05]	260.0 [10.24]	132.5 [5.22]	18.0 [0.71]	13.0 [0.51]	13.0 [0.51]	18.0 [0.71]

2 Servo oil pump HSP-050-150-43B



Component	Model Number	Quantity
Motor	ECMA-KR221FPS	1
Oil pump	EIPC3-050RK23	1
Pressure sensor	WIKA A-10	1

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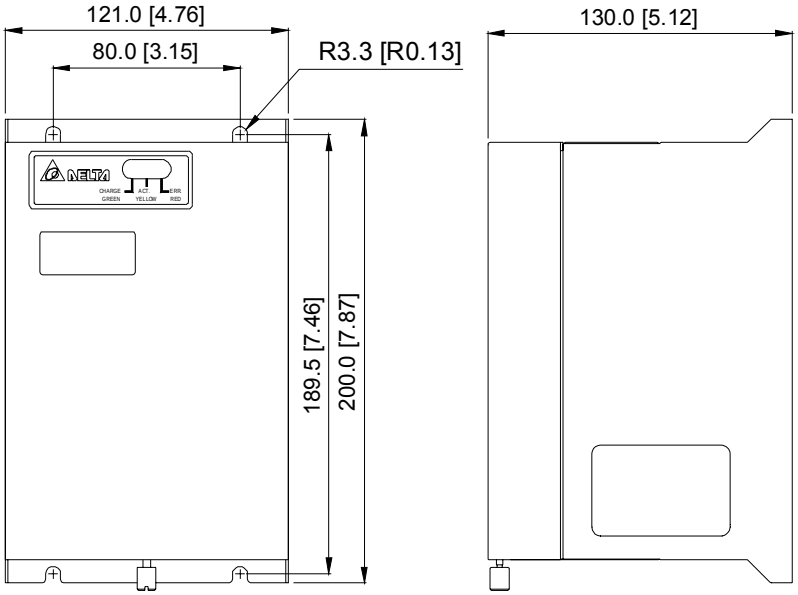
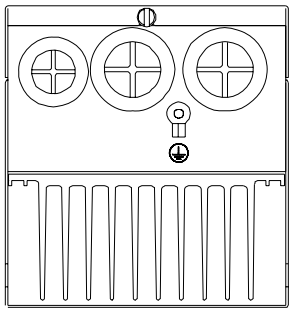
3 Accessories Kit HESP-125-H-B-43

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※1 Braking unit	VFDB-4045	1
※2 Braking resistor	BR2250W015	1

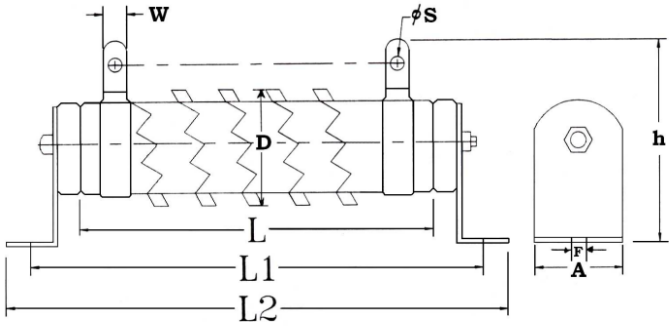
Coding device cable 5m*1	Magnetic ring of power cable*3	Sensor clamp*1

※1 Braking unit VFDB-4045





※2 Braking resistor 2250W 15Ω Unit: min



L ± 5	L1 ± 10	L2 ± 10	D ± 5	W ± 0.2	S ± 0.1	A ± 1	F ± 0.1	h ± 10
500	584	610	72	15	8.1	65	9.1	130

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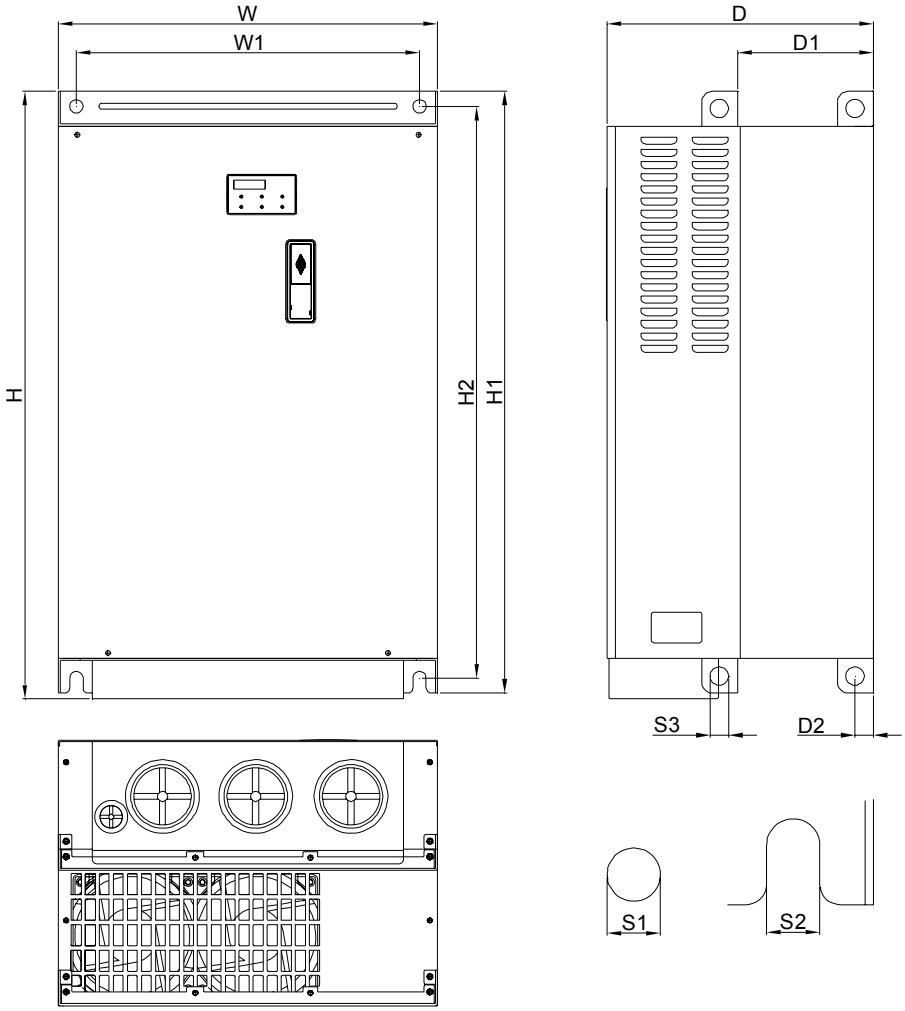
HES160G43A

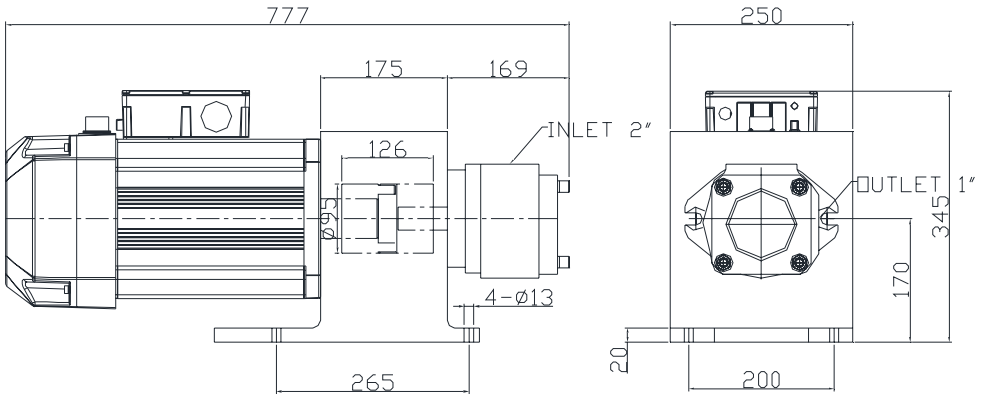
1 Servo controller VFD300VL43A-J



Unit: mm[inch]

W	W1	H	H1	H2	D	D1	D2	S1	S2	S3
370.0 [14.57]	335.0 [13.19]	-	589.0 [23.19]	560.0 [22.05]	260.0 [10.24]	132.5 [5.22]	18.0 [0.71]	13.0 [0.51]	13.0 [0.51]	18.0 [0.71]

2 Servo oil pump HSP-064-150-43A



Component	Model Number	Quantity
Motor	ECMA-KR221FPS	1
Oil pump	EIPC5-064RA23	1
Pressure sensor	WIKA A-10	1

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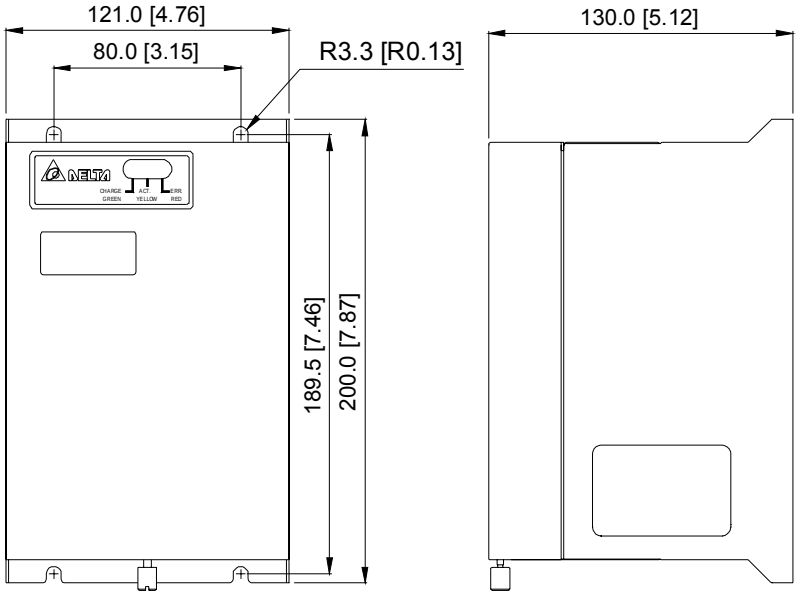
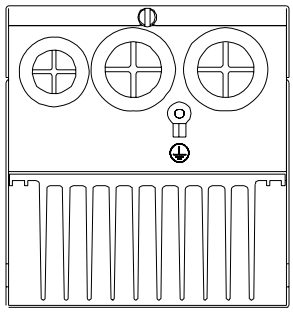
3 Accessories Kit HESP-160-G-B-43

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※1 Braking unit	VFDB-4045	1
※2 Braking resistor	BR2250W015	1

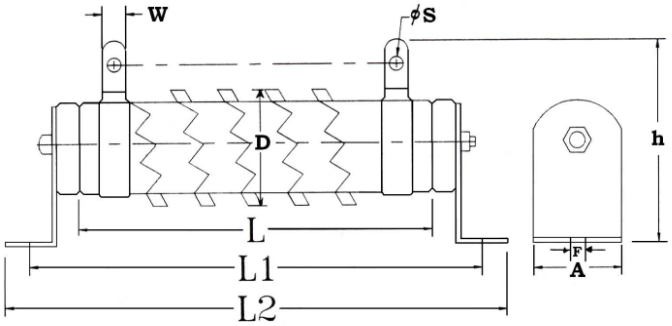
Coding device cable 5m*1	Magnetic ring of power cable*3	Sensor clamp*1

※1 Braking unit VFDB-4045





※2 Braking resistor 2250W 15Ω Unit: min



L ± 5	L1 ± 10	L2 ± 10	D ± 5	W ± 0.2	S ± 0.1	A ± 1	F ± 0.1	h ± 10
500	584	610	72	15	8.1	65	9.1	130

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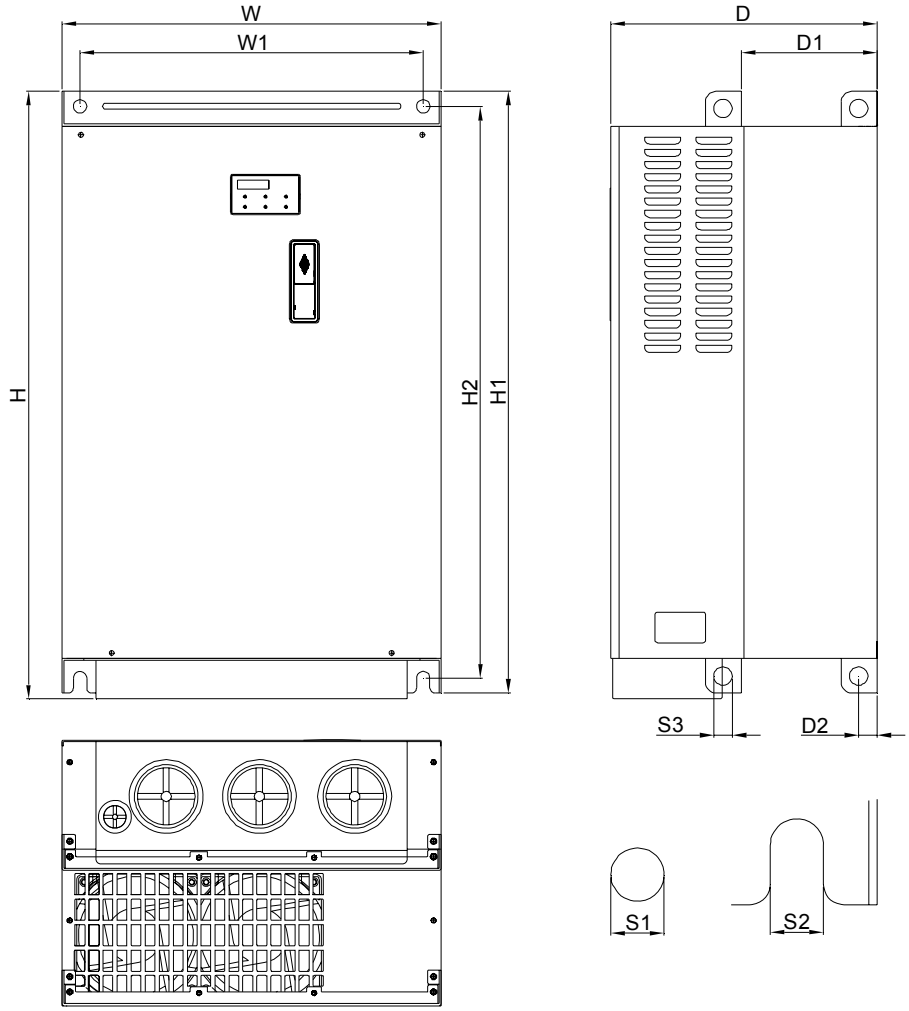
HES160H43A

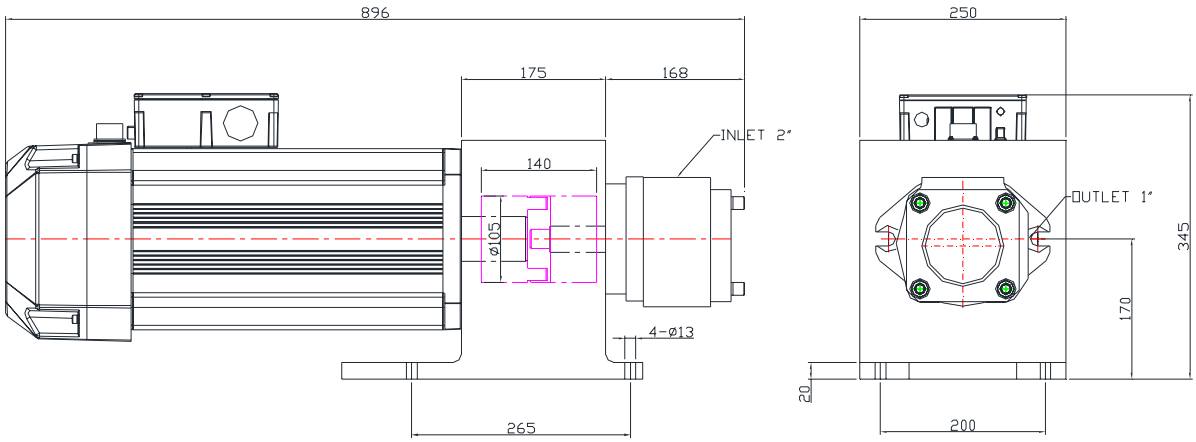
1 Servo controller VFD370VL43A-J



Unit: mm[inch]

W	W1	H	H1	H2	D	D1	D2	S1	S2	S3
370.0 [14.57]	335.0 [13.19]	-	589.0 [23.19]	560.0 [22.05]	260.0 [10.24]	132.5 [5.22]	18.0 [0.71]	13.0 [0.51]	13.0 [0.51]	18.0 [0.71]

2 Servo oil pump HSP-064-200-43A



Component	Model Number	Quantity
Motor	ECMA-KR222APS	1
Oil pump	EIPC5-064RA23	1
Pressure sensor	WIKA A-10	1

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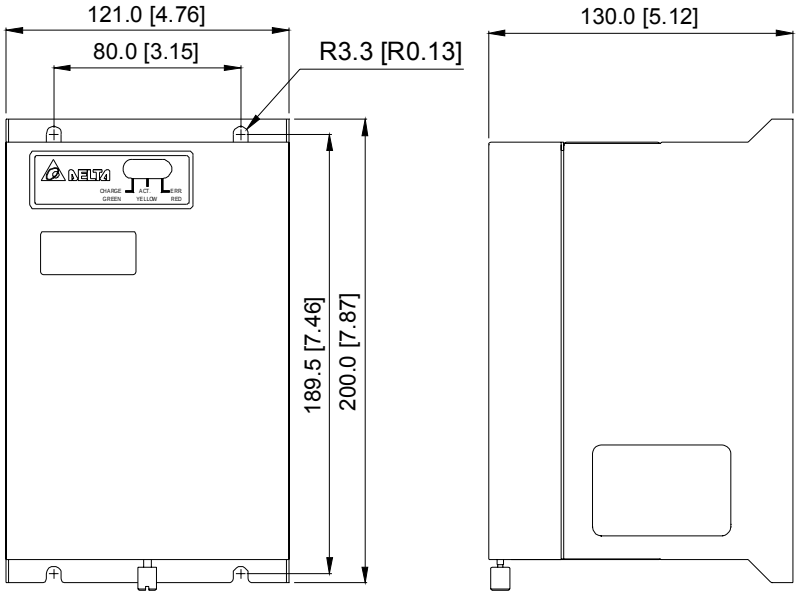
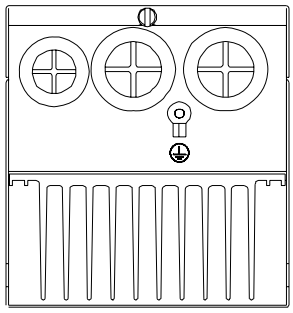
3 Accessories Kit HESP-160-H-B-43

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※1 Braking unit	VFDB-4045	1
※2 Braking resistor	BR3K0W015	1

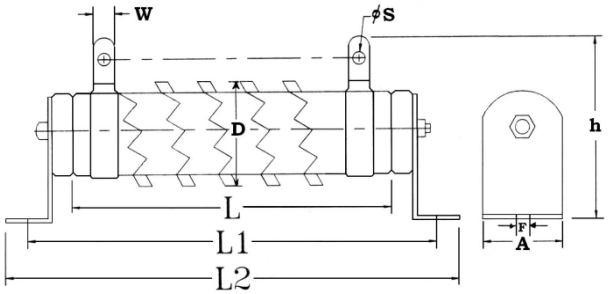
Coding device cable 5m*1	Magnetic ring of power cable*3	Sensor clamp*1

※1 Braking unit VFDB-4045





※2 Braking resistor 3000W 15Ω Unit: min



L ± 5	L1 ± 10	L2 ± 10	D ± 5	W ± 0.2	S ± 0.1	A ± 1	F ± 0.1	h ± 10
650	734	760	72	15	8.1	65	9.1	130

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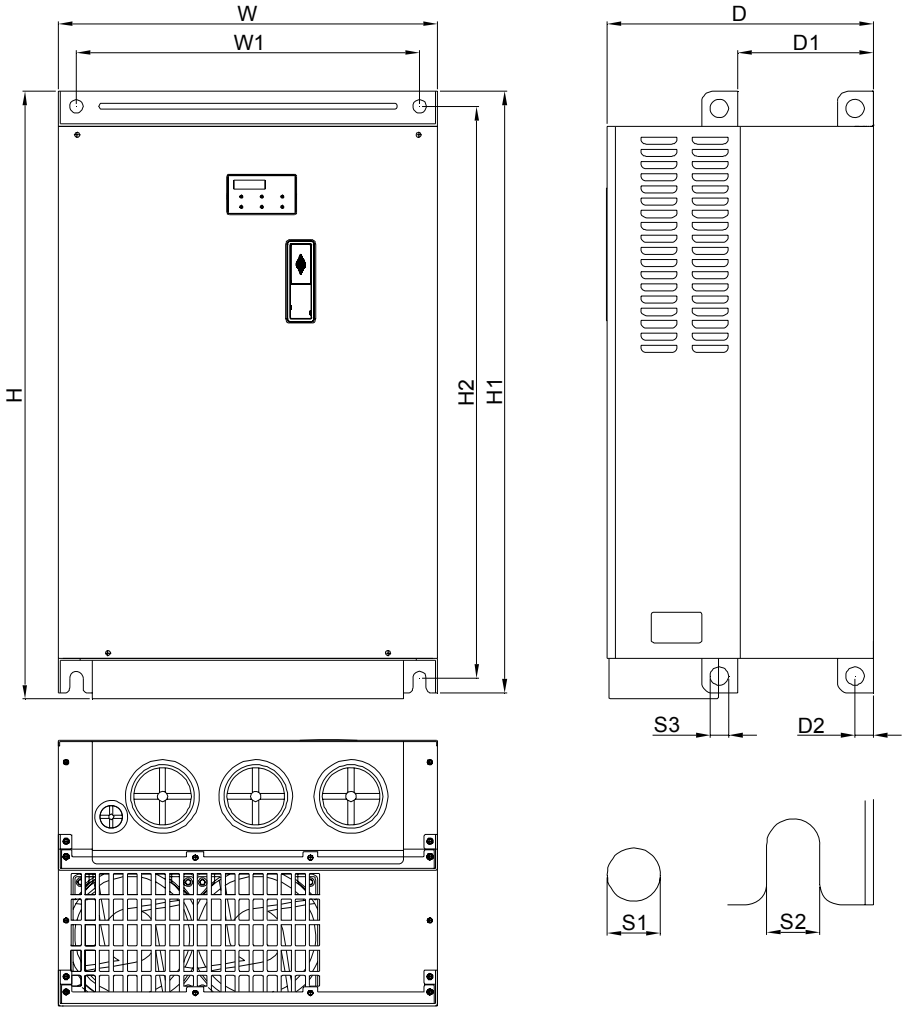
HES200G43A

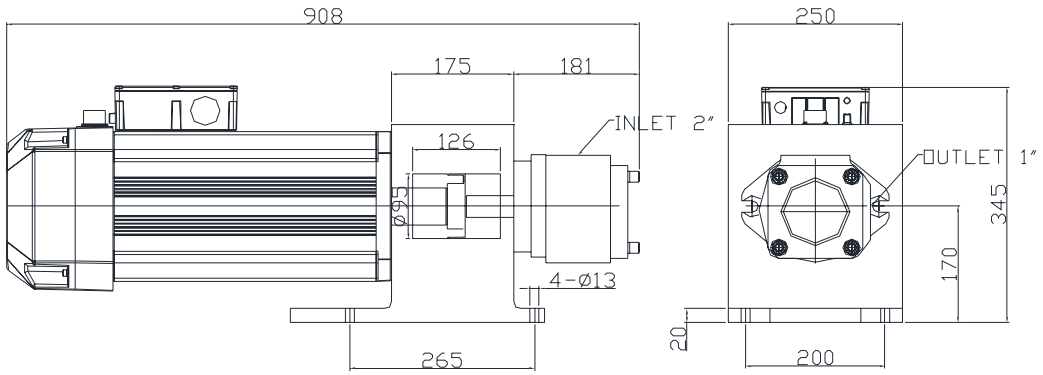
1 Servo controller VFD370VL43A-J



Unit: mm[inch]

W	W1	H	H1	H2	D	D1	D2	S1	S2	S3
370.0 [14.57]	335.0 [13.19]	-	589.0 [23.19]	560.0 [22.05]	260.0 [10.24]	132.5 [5.22]	18.0 [0.71]	13.0 [0.51]	13.0 [0.51]	18.0 [0.71]

2 Servo oil pump HSP-080-200-43A



Component	Model Number	Quantity
Motor	ECMA-KR222APS	1
Oil pump	EIPC5-080-RA23-10	1
Pressure sensor	WIKA A-10	1

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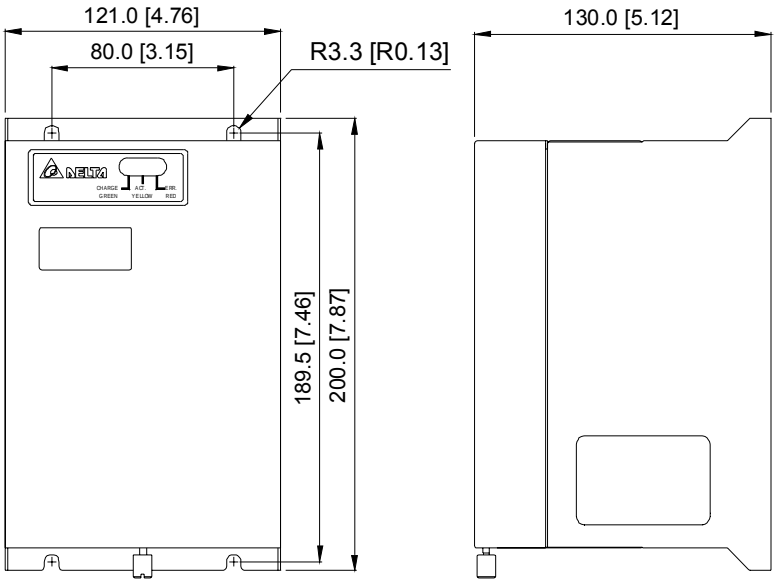
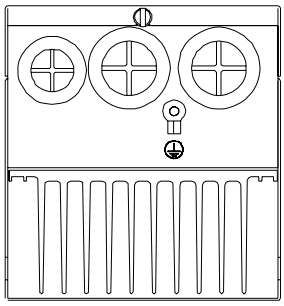
3 Accessories Kit HESP-200-G-B-43

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※1 Braking unit	VFDB-4045	1
※2 Braking resistor	BR3K0W015	1

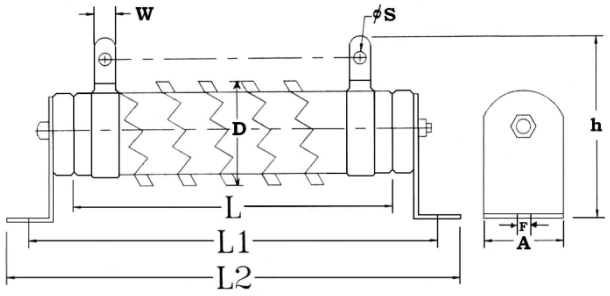
Coding device cable 5m*1	Magnetic ring of power cable*3	Sensor clamp*1

※1 Braking unit VFDB-4045





※2 Braking resistor 3000W 15Ω Unit: min



L ± 5	L1 ± 10	L2 ± 10	D ± 5	W ± 0.2	S ± 0.1	A ± 1	F ± 0.1	h ± 10
650	734	760	72	15	8.1	65	9.1	130

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Appendix B Optional Accessories

B-1 Non-fuse Circuit Breaker Chart
B-2 Reactor
B-3 Digital Keypad KPV-CE01
B-4 Communication Card
B-5 EMI Filter
B-6 Brake Unit

CAUTION	☑ This VFD-VL AC motor drive has gone through rigorous quality control tests at the factory before shipment. If the package is damaged during shipping, please contact your dealer. ☑ All accessories manufactured by us are to be used exclusively in the Hybrid Servo Controllers made by us. Please do not purchase accessories with unknown manufacturing information and use them on our Hybrid Servo Controllers to avoid the risk of malfunction.

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B-1 Non-fuse Circuit Breaker Chart

UL certification: Per UL 508, paragraph 45.8.4, part a.

The rated current of the breaker shall be within 2 to 4 times rated input current of hybrid servo Controller.

Hybrid Servo Controller.

3-phase	
Model Number	Recommended Input Current (A)
VFD055VL23A-J	50
VFD055VL43A-J	30
VFD075VL23A-J	60
VFD075VL43A-J	40
VFD110VL23A-J	100
VFD110VL43A-J	50
VFD150VL23A-J	125
VFD150VL43A-J	60
VFD185VL23A-J	150
VFD185VL43A-J	75

3-phase	
Model Number	Recommended Input Current (A)
VFD220VL23A-J	175
VFD220VL43A-J	100
VFD300VL23A-J	225
VFD300VL43A-J	125
VFD370VL23A-J	250
VFD370VL43A-J	150
VFD450VL43A-J	175
VFD550VL43A-J	250
VFD750VL43A-J	300

Smaller fuses than those shown in the table are permitted.

230V Model Number	Input Current I (A)	Line Fuse	
		I (A)	Bussmann P/N
VFD055VL23A-J	25	50	JJN-50
VFD075VL23A-J	31	60	JJN-60
VFD110VL23A-J	47	100	JJN-100
VFD150VL23A-J	60	125	JJN-125
VFD185VL23A-J	80	150	JJN-150
VFD220VL23A-J	90	175	JJN-175
VFD300VL23A-J	106	225	JJN-225
VFD370VL23A-J	126	250	JJN-250

460V Model Number	Input Current I (A)	Line Fuse	
		I (A)	Bussmann P/N
VFD055VL43A-J	14	30	JJN-30
VFD075VL43A-J	18	40	JJN-40
VFD110VL43A-J	24	50	JJN-50
VFD150VL43A-J	31	60	JJN-60
VFD185VL43A-J	39	75	JJN-70
VFD220VL43A-J	47	100	JJN-100
VFD300VL43A-J	56	125	JJN-125
VFD370VL43A-J	67	150	JJN-150
VFD450VL43A-J	87	175	JJN-175
VFD550VL43A-J	101	250	JJN-250
VFD750VL43A-J	122	300	JJN-300

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B-2 Reactor

B-2-1 AC Input Reactor Recommended Value

460V, 50/60Hz, 3-phase

kW	HP	Fundamental Amps	Maximum Continuous Amps	Inductance（mh）	
				3% Impedance	5% Impedance
5.5	7.5	12	18	2.5	4.2
7.5	10	18	27	1.5	2.5
11	15	25	37.5	1.2	2
15	20	35	52.5	0.8	1.2
18.5	25	35	52.5	0.8	1.2
22	30	45	67.5	0.7	1.2
30	40	55	82.5	0.5	0.85
37	50	80	120	0.4	0.7
45	60	80	120	0.4	0.7
55	75	100	150	0.3	0.45
75	100	130	195	0.2	0.3

230V, 50/60Hz, 3-phase

kW	HP	Fundamental Amps	Maximum Continuous Amps	Inductance（mh）	
				3% Impedance	5% Impedance
5.5	7.5	25	37.5	0.5	1.2
7.5	10	35	52.5	0.4	0.8
11	15	55	82.5	0.25	0.5
15	20	80	120	0.2	0.4
18.5	25	80	120	0.2	0.4
22	30	100	150	0.15	0.3
30	40	130	195	0.1	0.2
37	50	160	240	0.075	0.15

460V, 50/60Hz, 3-phase

kW	HP	Fundamental Amps	Maximum Continuous Amps	Inductance（mh）	
				3% Impedance	5% Impedance
5.5	7.5	18	27	1.5	2.5
7.5	10	18	27	1.5	2.5
11	15	25	37.5	1.2	2
15	20	35	52.5	0.8	1.2
18.5	25	45	67.5	0.7	1.2
22	30	45	67.5	0.7	1.2
30	40	80	120	0.4	0.7
37	50	80	120	0.4	0.7
45	60	100	150	0.3	0.45
55	75	130	195	0.2	0.3
75	100	160	240	0.15	0.23

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Applications for AC Reactor

Connected in input circuit

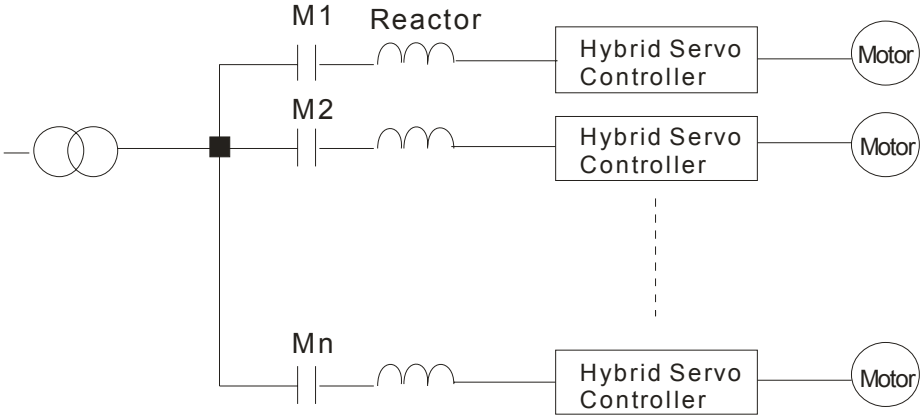
Application 1

When more than one drive is connected to the same power, one of them is ON during operation.

Question

When applying to one of the Hybrid Servo Controller, the charge current of capacity may cause voltage ripple. The Hybrid Servo Controller may damage when over current occurs during operation.

Correct wiring



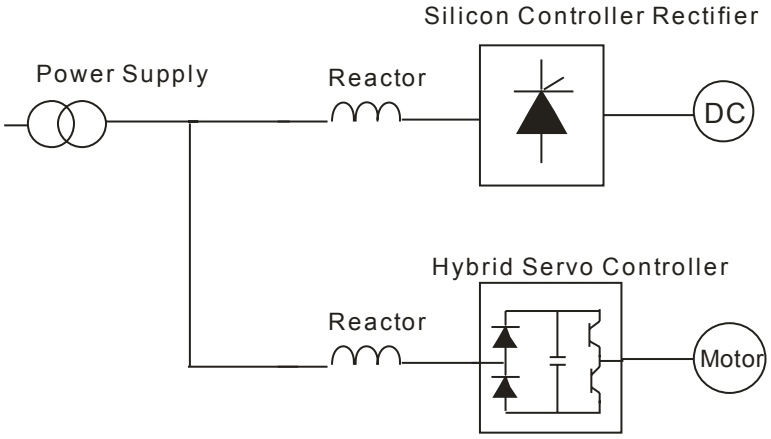
Application 2

Silicon rectifier and Hybrid Servo Controller is connected to the same power.

Question

Surges will be generated at the instant of silicon rectifier switching on/off. These surges may damage the mains circuit.

Correct wiring



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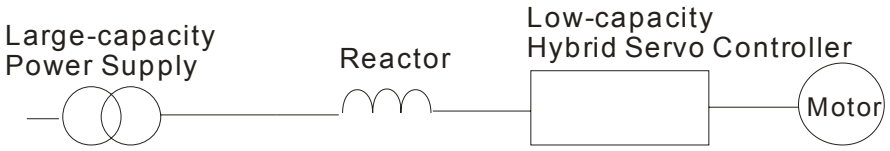
Application 3

Used to improve the input power factor, to reduce harmonics and provide protection from AC line disturbances. (Surges, switching spikes, short interruptions, etc.). AC line reactor should be installed when the power supply capacity is 500kVA or more and exceeds 6 times the inverter capacity, or the mains wiring distance ≤10m.

Question

When power capacity is too large, line impedance will be small and the charge current will be too large. That may damage Hybrid Servo Controller due to higher rectifier temperature.

Correct wiring



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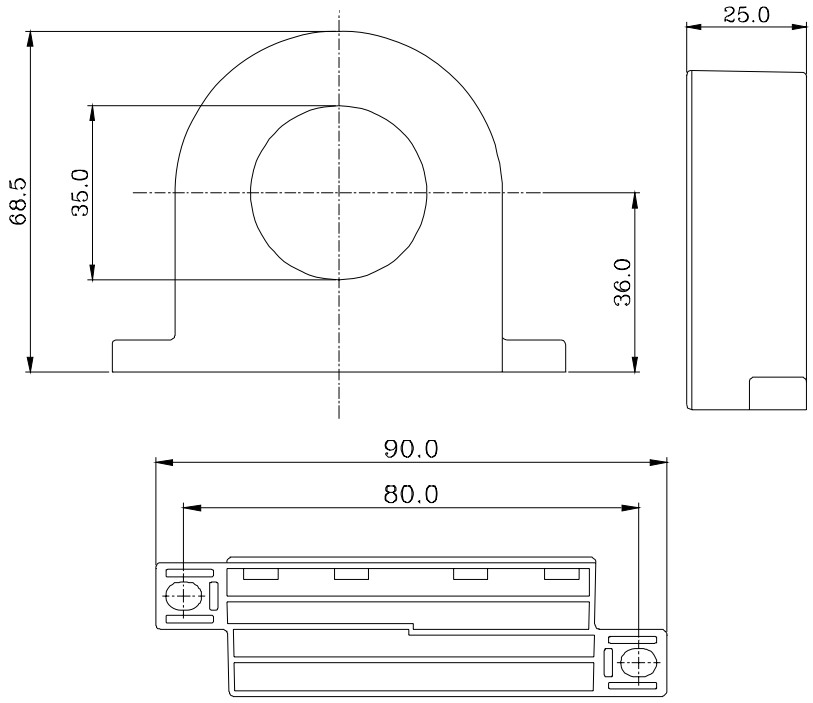
B-2-2 Zero Phase Reactor

RF220X00A UNIT: mm(inch)



Cable type (Note)	Recommended Wire Size (mm^2)			Qty.	Wiring Method
	AWG	mm^2	Nominal (mm^2)		
Single-core	≤10	≤5.3	≤5.5	1	Figure A
	≤2	≤33.6	≤38	3	Figure B
Three-core	≤12	≤3.3	≤3.5	1	Figure A
	≤1	≤42.4	≤50	3	Figure B

NOTE

600V insulated power cable

1. The above table is for reference only. Please choose cables with suitable types and diameters, so that the cable must be of the right size to pass through the center of the reactor.
2. Please do not cross the ground wire. Only the motor wire or the power cable is to be threaded.
3. When long motor output cable I used, the zero-phase reactor may be needed to minimize the effect of radiation.

Figure A

Each wire must be wrapped at least three times when it threads the zero phase reactor, with the reactor placed as close to the Hybrid Servo Controller as possible.

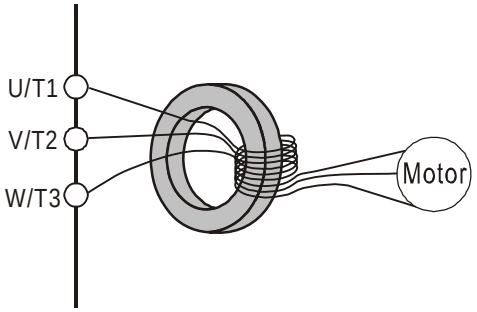
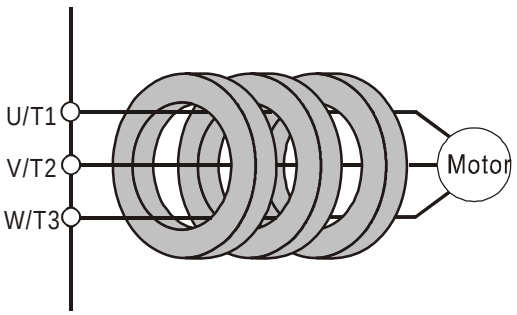


Figure B

Please thread the wire directly through the three zero phase reactors aligned in parallel.



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B-2-3 DC Reactor

230V DC Choke

Input Voltage	kW	HP	DC Amps	Inductance（mh）
230Vac 50/60Hz 3-Phase	5.5	7.5	32	0.85
	7.5	10	40	0.75
	11	15	62	Built-in
	15	20	92	Built-in
	18.5	25	110	Built-in
	22	30	125	Built-in
	30	40	-	Built-in
	37	50	-	Built-in

460V DC Choke

Input Voltage	kW	HP	DC Amps	Inductance（mh）
460Vac 50/60Hz 3-Phase	5.5	7.5	18	3.75
	7.5	10	25	4.00
	11	15	32	Built-in
	15	20	50	Built-in
	18.5	25	62	Built-in
	22	30	80	Built-in
	30	40	92	Built-in
	37	50	110	Built-in
	45	60	125	Built-in
	55	75	200	Built-in
	75	100	240	Built-in

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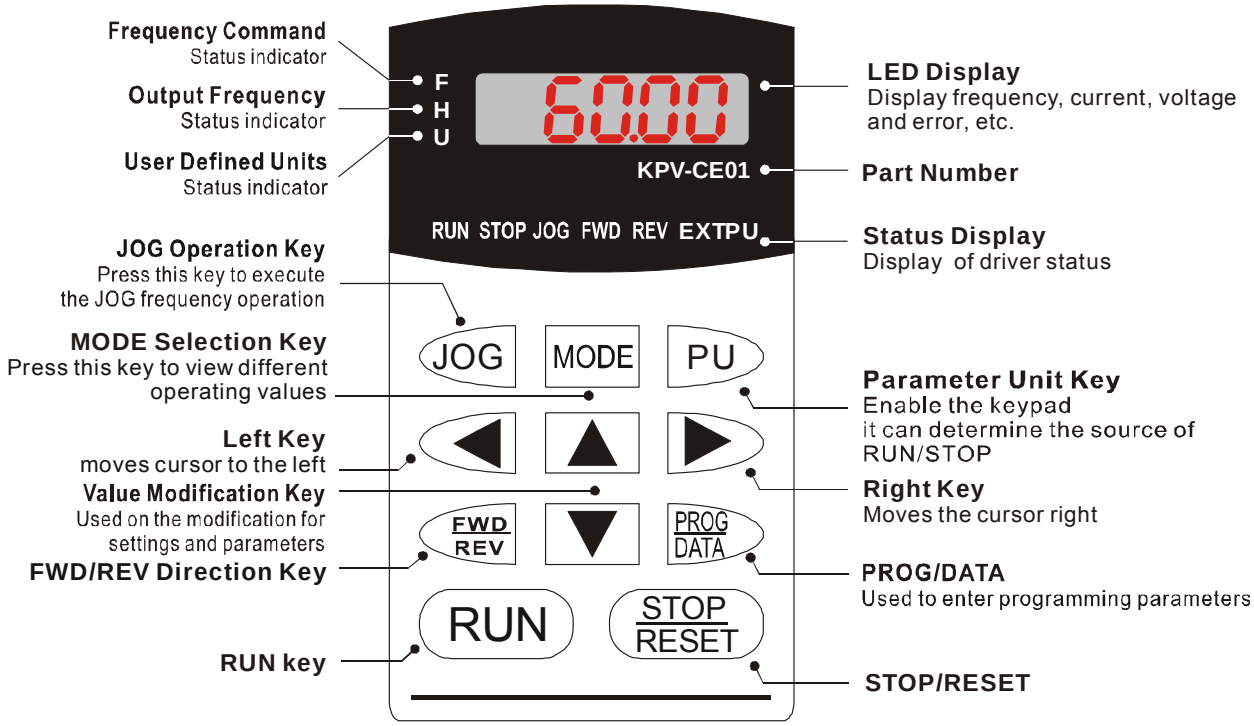
B-3 Digital Keypad KPV-CE01

The digital keypad is the display of VFD-VJ series. The following keypad appearance is only for reference and please see the product for actual appearance.

Description of the Digital Keypad KPV-CE01



Display Message	Description
F 60.00	Displays the drive Master frequency.
H 50.00	Displays the actual output frequency present at terminals U/T1, V/T2, and W/T3.
U 1800.0	User defined unit (where U = F x Pr.00-05)
A 5.0	Displays the load current
c 20	The counter value (C).
01-00	Displays the selected parameter.
10	Displays the actual stored value of the selected parameter.
EF	External Fault.
-End-	Display “End” for approximately 1 second if input has been accepted. After a parameter value has been set, the new value is automatically stored in memory.
-Err-	Display “Err”, if the input is invalid.

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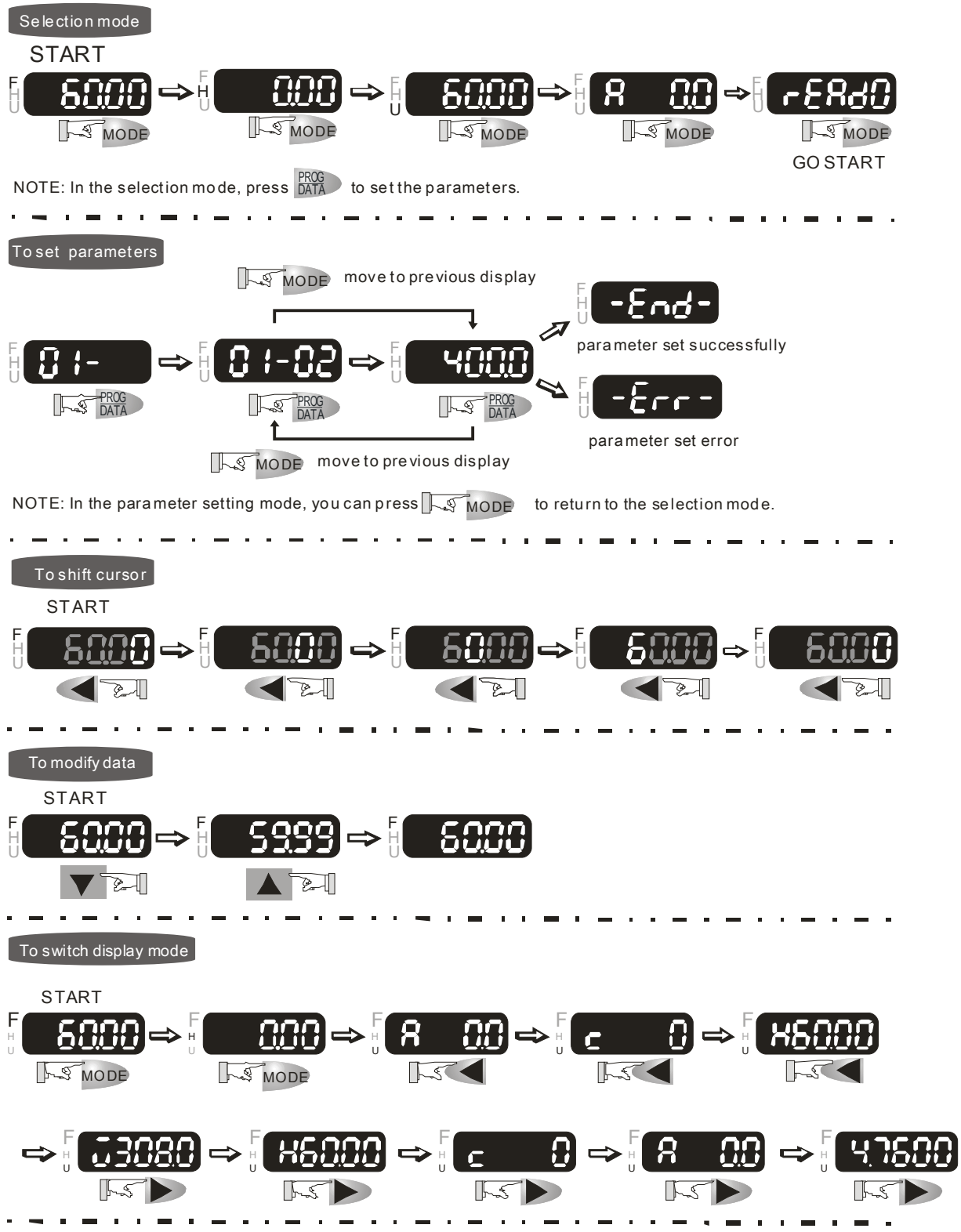
How to Operate the Digital Keypad KPV-CE01



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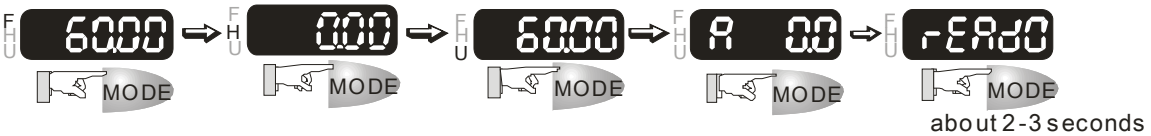
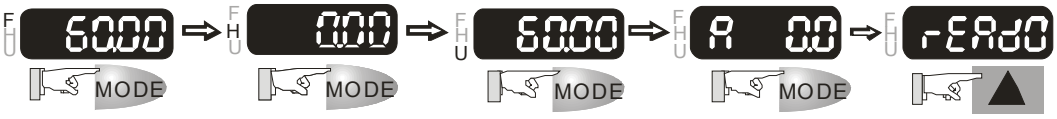
To copy parameters 1

Copy parameters from the Drive to the KPV-CE01



start blinking

It will display "End" to indicate that the first parameter is saved, then return to "rEAd0".



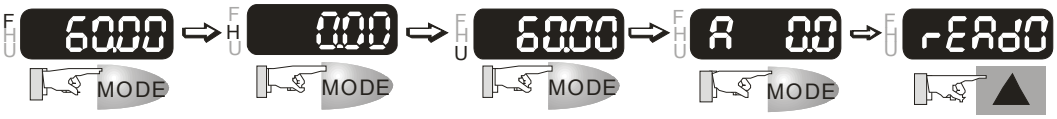
about 2-3 seconds

start blinking

It will display "End" to indicate that the second parameter is saved, then return to "rEAd1".

To copy parameters 2

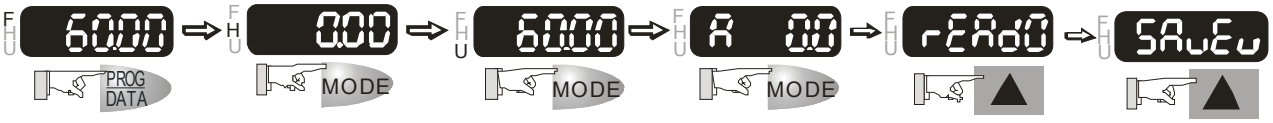
Copy parameters from the KPV-CE01 to the Drive



about 2-3 seconds

start blinking

It will display "End" to indicate that the first parameter is saved, then return to "SAvEv".



about 2-3 seconds

start blinking

It will display "End" to indicate that the second parameter is saved, then return to "SAvEv".

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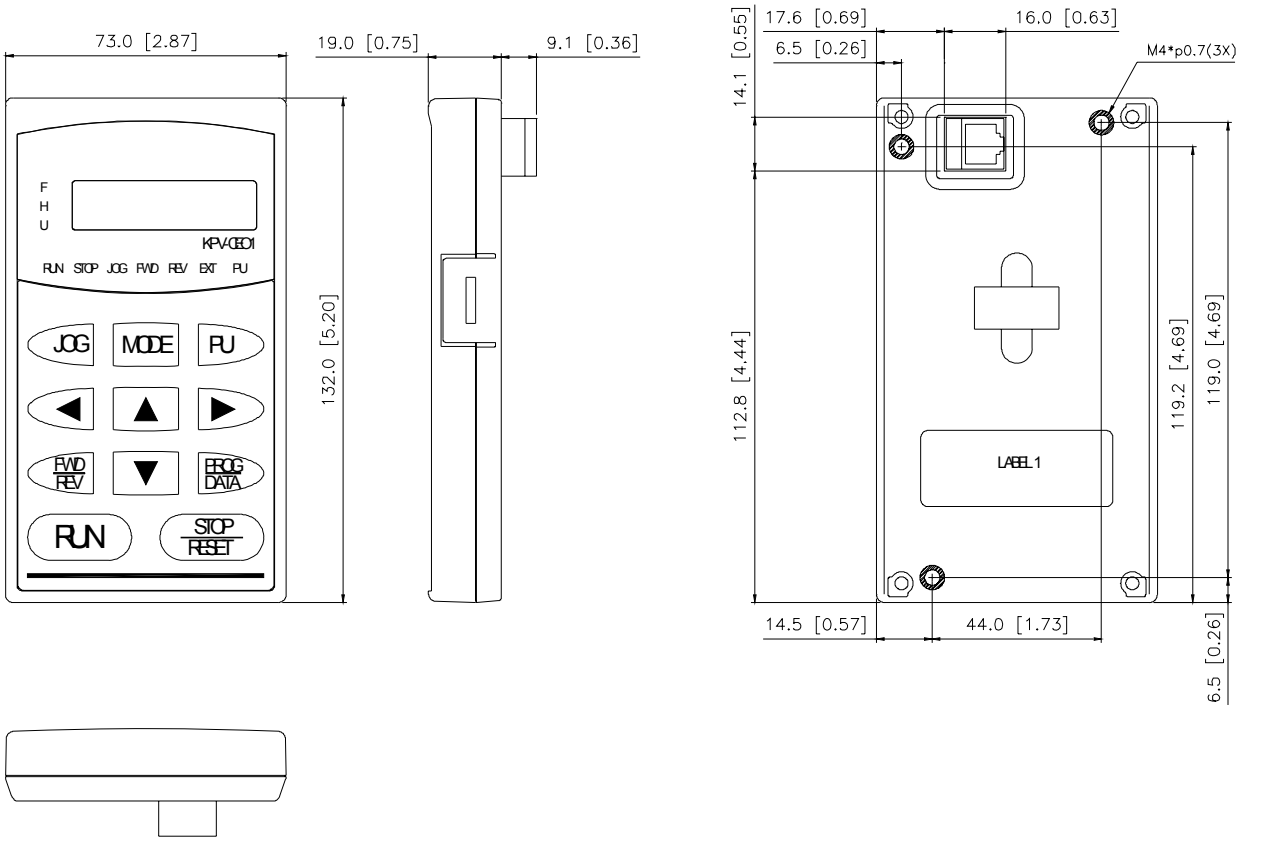
Dimension of the Digital Keypad (KPV-CE01)

Unit: mm [inch]



Reference Table for the LCD Display of the Digital Keypad

Number	0	1	2	3	4	5	6	7	8	9
LCD	0	1	2	3	4	5	6	7	8	9
English Alphabet	A	b	Cc	d	E	F	G	Hh	I	Jj
LCD	A	b	C c	d	E	F	G	H h	I	J j
English Alphabet	K	L	n	Oo	P	q	r	S	Tt	U
LCD	K	L	n	O o	P	q	r	S	T t	U
English Alphabet	v	Y	Z							
LCD	v	y	Z							

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B-4 Communication Card

EMVJ-MF01

Terminal	Description
⏚	Ground
SG-	RS485 connection points
SG+	
GND	Common Signal Terminal

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B-5 EMI Filter

Driver	Filter Model No.	Web link of references
VFD055VL23A-J VFD075VL23A-J VFD150VL43A-J	KMF336A	http://www.dem-uk.com/roxburgh/products/emc_emi_industrial_filters/ KMF336A Three Phase Industrial Mains Filters - High Performance 36 Amps
VFD110VL23A-J VFD185VL43A-J VFD220VL43A-J	KMF350A	http://www.dem-uk.com/roxburgh/products/emc_emi_industrial_filters/ KMF350 Three Phase Industrial Mains Filters - General Purpose 50 Amps
VFD150VL23A-J VFD300VL43A-J VFD370VL43A-J	KMF370A	http://www.dem-uk.com/roxburgh/products/emc_emi_industrial_filters/ KMF370A Three Phase Industrial Mains Filters - High Performance 70 Amps
VFD185VL23A-J VFD220VL23A-J VFD450VL43A-J	KMF3100A	http://www.dem-uk.com/roxburgh/products/emc_emi_industrial_filters/ KMF3100A Three Phase Industrial Mains Filters - High Performance 100 Amps
VFD300VL23A-J VFD370VL23A-J VFD550VL43A-J VFD750VL43A-J	KMF3150A	http://www.dem-uk.com/roxburgh/products/emc_emi_industrial_filters/ KMF3150A Three Phase Industrial Mains Filters - High Performance 150 Amps
VFD055VL43A-J	KMF318A	http://www.dem-uk.com/roxburgh/products/emc_emi_industrial_filters/ KMF318 Three Phase Industrial Mains Filters - General Purpose 18 Amps
VFD075VL43A-J VFD110VL43A-J	KMF325A	http://www.dem-uk.com/roxburgh/products/emc_emi_industrial_filters/ KMF325A Three Phase Industrial Mains Filters - High Performance 25 Amps

EMI Filter Installation

All electrical equipment, including drives, will generate high-frequency/low-frequency noise and will interfere with peripheral equipment by radiation or conduction when in operation. By using an EMI filter with correct installation, much interference can be eliminated. It is recommended to use DELTA EMI filter to have the best interference elimination performance.

We assure that it can comply with following rules when drive and EMI filter are installed and wired according to user manual:

1. EN61000-6-4
2. EN61800-3: 1996
3. EN55011 (1991) Class A Group 1

General precaution

1. EMI filter and drive should be installed on the same metal plate. It is recommended to install the drive on the filter.
2. Please wire as short as possible. Metal plate should be grounded. The cover of EMI filter and drive or grounding should be fixed on the metal plate and the contact area should be as large as possible.

Choose suitable motor cable and precautions

Improper installation and choice of motor cable will affect the performance of EMI filter. Be sure to observe the following precautions when selecting motor cable.

1. Use the cable with shielding (double shielding is the best). The shielding on both ends of the motor cable should be grounded with the minimum length and maximum contact area.
2. Remove any paint on metal saddle for good ground contact with the plate and shielding as shown in figure 1.
3. The shielding net of motor cable and the plate must be connected correctly. The shielding net on the two ends of motor cable should be fixes by the metal saddle and the plate. See figure 2 for correct connection.

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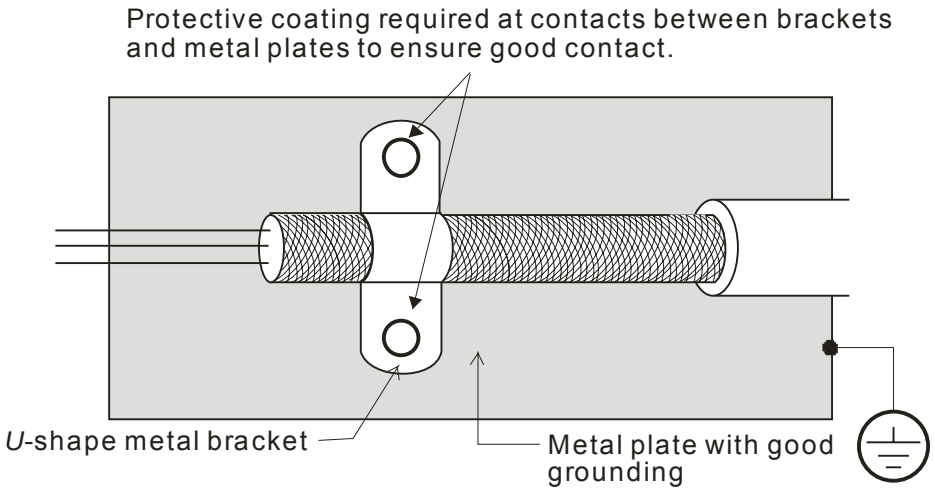
Protective coating required at contacts between brackets and metal plates to ensure good contact.
U-shape metal bracket
Metal plate with good grounding

Figure 1

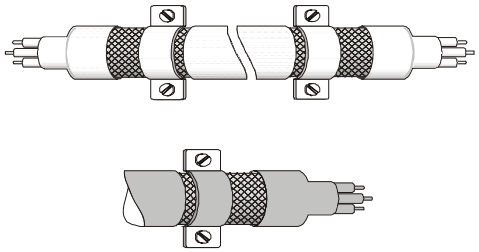

Figure 2

The length of motor cable

When motor is driven by a drive of PWM type, the motor terminals will experience surge voltages easily due to components conversion of drive and cable capacitance. When the motor cable is very long (especially for the 460V series), surge voltages may reduce insulation quality. To prevent this situation, please follow the rules below:

Use a motor with enhanced insulation. Connect an output reactor (optional) to the output terminals of the drive. The length of the cable between drive and motor should be as short as possible (10 to 20 m or less).

For models 7.5hp/5.5kW and above:

Insulation level of motor	1000V	1300V	1600V
460Vac input voltage	66 ft (20m)	328 ft (100m)	1312 ft (400m)
230Vac input voltage	1312 ft (400m)	1312 ft (400m)	1312 ft (400m)

If the length is too long, the stray capacitance between cables will increase and may cause leakage current. It will activate the protection of over current, increase leakage current or not insure the correction of current display. The worst case is that drive may damage.
To drive the 460V series motor, if there is one relay installed between the Hybrid Servo Controller and motor to protect the motor from over-heating, the relay might malfunction even if the length of the wire is below 50 meters. Thus, a filter for output current shall be added (optional for purchase).

NOTE:

- ☑ When a thermal O/L relay protected by motor is used between Hybrid Servo Controller and motor, it may malfunction (especially for 460V series), even if the length of motor cable is only 165 ft (50m) or less. To prevent it, please use a filter.
- ☑ Never connect phase lead capacitors or surge absorbers to the output terminals of the Hybrid Servo Controller.

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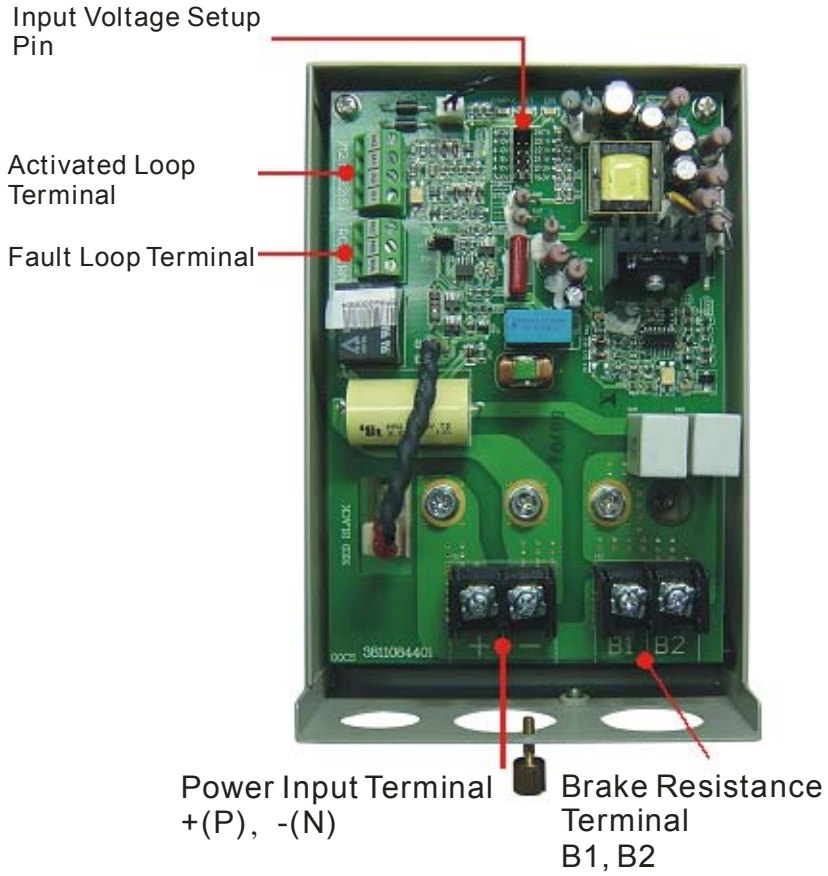
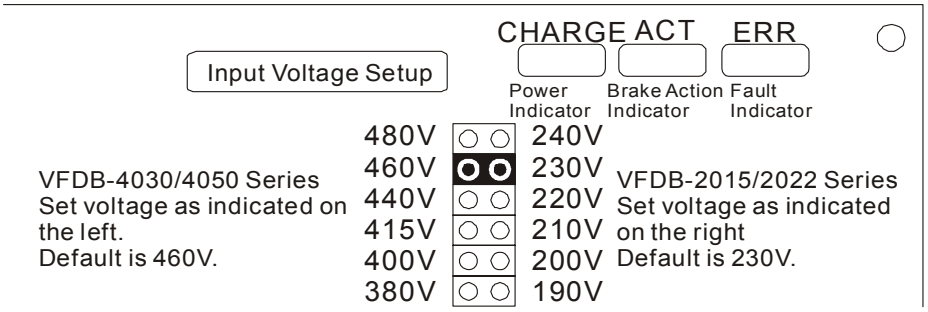
B-6 Brake Unit

Individual Parts and Function Explanation


Input Voltage Setup Pin
Activated Loop Terminal
Fault Loop Terminal
Power Input Terminal +(P), -(N)
Brake Resistance Terminal B1, B2



Input voltage setting for VFDB-2015/2022/4030/4045

The Voltage Settings

1. Adjust Voltage: The + (P) and – (N) sides of the hydraulic servo motor controller are the DC power source of the control unit. Therefore, after wiring and before operation, it is very important to set the voltage of the control unit according to the input voltage of the hydraulic servo motor controller. This setting will affect the state of activation voltage of the control unit. The following table shows the state address of individual voltage actions.

Voltage: 230 VAC	Braking Start-up voltage DC Bus (+(P), -(N)) Voltage	Voltage: 230 VAC	Braking Start-up voltage DC Bus (+(P), -(N)) Voltage
190Vac	330Vdc	380Vac	660Vdc
200Vac	345Vdc	400Vac	690Vdc
210Vac	360Vdc	415Vac	720Vdc
220Vac	380Vdc	440Vac	760Vdc
230Vac	400Vdc	460Vac	800Vdc
240Vac	415Vdc	480Vac	830Vdc

Table 1: The Selection of Power Voltage and Operation Potential of PN DC Voltage

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Terminal Wire Gauge

Circuit	Terminal Mark		Wire Gauge AWG (mm^2)	Screw	Torque
Power Input Circuit	+ (P)、- (N)		10～12AWG (3.5～5.5mm^2)	M4	18 kgf-cm (15.6 in-lbf)
Braking Resistor	B1、B2		10～12AWG (3.5～5.5mm^2)	M4	18 kgf-cm (15.6 in-lbf)
SLAVE Circuit	Output	M1、M2	20～18AWG (0.25～0.75mm^2) (with shielded wires)	M2	4 kgf-cm (3 in-lbf)
	Input	S1、S2			
Fault Circuit	RA、RB、RC		20～18AWG (0.25～0.75mm^2)	M2	4 kgf-cm (3 in-lbf)

Specifications

Voltage Class		230V Series		460V Series	
Model VFDB-		2015	2022	4030	4045
Max. Motor Capacity (kW)		15	22	30	45
Output Rating	Max. Discharge Current (A) 10%ED	40	60	40	60
	Continuous Discharge Current (A)	15	20	15	18
	Braking Start-up Voltage (DC)	330/345/360/380/ 400/415±3V		660/690/720/760/ 800/830±6V	
Input Rating	DC Voltage	200~400VDC		400~800VDC	
Min. Equivalent Resistor for Each Braking Unit		10Ω	6.8Ω	20Ω	13.6Ω
Protection	Heat Sink Overheat	Temperature over +95℃ (203°F)			
	Alarm Output	Relay contact 5A120Vac/28Vdc(RA.RB.RC)			
	Power Charge Display	Blackout until bus (+~-) voltage is below 50VDC			
Environment	Installation Location	Indoor (no corrosive gases, metallic dust)			
	Operating Temperature	-10℃～+50℃ (14°F to 122°F)			
	Storage Temperature	-20℃～+60℃ (-4°F to 140°F)			
	Humidity	90% Non-condensing			
	Vibration	20Hz 以下 9.8m/S^2(1G)、20～50Hz 2m/S^2(0.2G)			
Mechanical Configuration		Wall-mounted enclosed type IP50			